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THE CLERK OF WORKS

THE CLERK OF WORKS

A HANDBOOK ON THE SUPERVISION OF BUILDING OPERATIONS

BY

GEORGE METSON

LICENTIATE R.I.B.A., M.R.SAN.I., MEMBER OF THE CONCRETE INSTITUTE
AUTHOR OF "THE BUILDER'S FOREMAN" AND "QUANTITY SURVEYING"
LECTURER ON BUILDING CONSTRUCTION (HIGHER DIVISION), AND BUILDERS' QUANTITIES (ORDINARY AND HONOURS GRADE) AT THE BOROUGH POLYTECHNIC, LONDON, S.E.

DEPT. OF ARCHITECTURE
MAY 22 1914
UNIVERSITY OF TORONTO

LONDON
CROSBY LOCKWOOD AND SON
7, STATIONERS' HALL COURT, E.C.
AND 5, BROADWAY, WESTMINSTER, S.W.
1913

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PRINTED BY
WILLIAM CLOWES AND SONS, LIMITED
LONDON AND BECCLES

PREFACE

THE Clerk of Works plays a very important part in building operations. His duties are many and various, requiring tact and diplomacy in their execution. There is no school at which he can be trained for the post. His natural abilities and general knowledge of building can only be assisted by some book dealing with the position he holds, or seeks to obtain. This little Handbook seeks to fill that need. It is primarily written to be of use to those successful applicants for the position of Clerk of Works on first appointment; but it is possible that those who have held the appointment for some years may gain some assistance from a perusal of its pages.

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THE CLERK OF WORKS

CHAPTER I

THE QUALIFICATIONS FOR THE POST

It is proposed in a brief manner to describe the qualifications, responsibilities, and duties of Clerks of Works. The post, which is an old and honourable one, has been held by men whose names have come down to this present age as masters of a craft, who, by their efforts and endeavours, have left marks behind them of the earnestness with which any and everything entrusted to them was thoroughly and nobly carried out, and whose work still remains as an example to all who now hold or seek to obtain the position and designation of "Clerk of Works."

The aim of this little book will be for it to act as a guide for the younger men upon first appointment as Clerk of Works, and maybe the older men with experience may yet be able to pick up from the notes given some item of interest or of merit which they have either ignored or but paid scant attention to in the past.

This first chapter will deal with the qualifications demanded of an aspirant for the much-sought-after position of Clerk of Works, and the reasons for asking the same.

The architect is unable to supervise personally the erection of the building over which he has pondered many hours in evolving the plans and elevations, which are either going to assist in making his reputation or in maintaining one already possessed.

The supervision must therefore be given over to an official, whose chief duty will be to act as architect's representative or overseer of the works. Such a man is called a Clerk of Works.

He should be selected by the architect, and be under his orders entirely, though he may be, and usually is, the servant by payment of the owner or body for whom the building is being erected; so that from the outset, the Clerk of Works is in the dual position of servant to two masters, from which it can be readily understood that tact and diplomacy must be important items in the qualifications to be sought for in a Clerk of Works.

Morale.

It is said no man can serve two masters, and yet Clerks of Works so often have to; and how many of them now know to their cost their powerlessness of effectively doing so? Particularly is this so with municipal appointments, where, although acting under the instructions of the Borough Surveyor or Engineer, they get visited by members on the Council, who probably think that by visiting works in progress they are watching the spending of the ratepayers' money.

It would be of little consequence if "watching" was all they did, but if they attempt to interfere with the construction or rate of progress, they may do more harm than good, as besides being for the most part non-technical, their suggestions can only be superficial or superfluous; and yet the Clerk of Works may have to listen and probably take note of their remarks, and even report them to the Borough Engineer. The lot of such a Clerk of Works is not a happy one, and every Borough Surveyor should see that his representative is not interfered with.

The Clerk of Works should only take orders from one person, and that should be his architect or surveyor, or their accredited assistants. Members of municipal bodies and building owners should be listened to with every care and patience, and there is no harm done in taking messages from them for the architect, though it is much better that these be given direct to the architect or surveyor by the Borough members or other owners concerned.

The Clerk of Works must not be the go-between of the architect or building owner—else, if anything goes wrong, he may sooner or later be the catspaw or scapegoat, which can only end in unpleasantness, even if not in dismissal; but tact, diplomacy, and a pleasing manner will help all to steer clear of such pits and traps. Remember your architect or surveyor will back you up—if they are strong men (as they should be) and you are in the right; but, of course, if you are in the wrong, you must bear the consequences of your errors.

Passing to his personal qualifications, there is "Honesty." Honesty is the keynote of success for every Clerk of Works. Honest in his work, and honest in his methods, must be the guiding thought in his every action. No matter how much labour, study and thought the architect puts into his design, they are all of little avail if the Clerk of Works does not carry out his duties faithfully and conscientiously.

He must see that he obtains out of the builder or contractor all that the specification, quantities, and drawings show, and that what he does get is the best of its kind within the bounds of the description given in the first of these documents, and to the true intent of the architect. He cannot honestly ask for more, but he must certainly see he gets no less.

His methods must at all times be above board; he must be scrupulous with his dealings with the contractor. It is easy for an unscrupulous Clerk of Works to add to his salary by accepting bribes or gifts from the builders; but once received, he becomes under the thumb of the builder, and he then has to approve work that he knows warrants rejection, and his position and peace of mind for the rest of the job is not to be envied. The underpaying of a Clerk of Works is a direct method of tempting him to such conduct, but more will be said of this later on.

These moral qualifications are more to the Clerk of Works than his technical ones. He cannot lose his technical and practical knowledge which forms these last, but the loss of his character for honesty damages once and for all his chances of obtaining another such post.

Technical qualifications.

The technical qualifications are many and varied, and differ according to the class of work upon which it is proposed to employ a Clerk of Works. For example, the qualifications for the post of Clerk of Works for a sewerage scheme must necessarily be distinct from those required of an applicant for the similar position on a large building contract. The former is an Engineering Clerk of Works, whilst the latter is that of an architect's Clerk of Works.

It is for the architect's Clerk of Works that these notes are written, though many of them will be applicable to other grades.

The applicant for the post of Clerk of Works for a large and important building will be expected to have a fair all-round knowledge of the uses, properties, and peculiarities of materials, a good knowledge of construction, the rudiments (at any rate) of quantity surveying, sanitary science as applied to buildings, and the use of the level. These form his technical qualifications, and in addition he must be able to write a businesslike letter, and make out an intelligent report, week by week, of the state of the building, showing progress or causes of delay.

Notes on letter writing and reports, etc., will be given in a later chapter. The technical qualifications mentioned above will now be amplified. The knowledge that a candidate for the post has should have been acquired by practical experience and experiment, backed up by theoretical study and book reading.

The knowledge of materials is perhaps the most important, as good construction with inferior materials will prove as disastrous as good materials with poor construction. Not only must the methods of manufacture, quarrying, and conversion be known, but also the properties and peculiarities of the materials employed, so that the Clerk of Works will be better able to judge of the possibilities.

If he knows the greatest depth of a bed of specified stone, he can at once perceive the greatest height for a column of that stone in one piece on its natural bed, and so avoid asking for impossibilities. If he sees that iron butts are specified for oak work, he can in good time point out the error to the architect, and so avoid the staining of the doors to the great detriment of their appearance, and the architect will only be too pleased for him to do so, as such an item could only be an oversight on the part of one of his staff.

Again, if he knows the sizes in which timber, etc., is readily obtainable, he may be able to save delay by insisting that those more difficult to procure should be bought at once, or, if necessary, by suggesting substitutes.

The Clerk of Works' knowledge of materials should in all cases embrace the nature, characteristics, defects, and the qualities obtainable of the various materials used in construction, and to know the cost of them is often of great advantage; the young Clerk of Works, while he is young, is advised to make some acquaintance with the chemistry of building materials.

A good public library will afford him opportunities of studying this subject, particularly so if he desires to make a thorough enquiry into some of the more important materials, when the purchase of the books would prove a costly item in his education.

Notes on the materials in most common use will be given under each trade in subsequent chapters, dealing with them from a Clerk of Works' point of view.

In addition to having a knowledge of the methods of manufacture and qualities obtainable, the Clerk of Works must know the quantities of materials required to execute a certain amount of finished work. This is of most importance when dealing with day work sheets.

The materials used are a check on the labour charged, and *vice-versa*, and it is no uncommon occurrence to find a foreman enter up and submit day-work sheets in which the labour and materials are by no means consistent.

As day work is bound to be necessary on any contract of fair size, it behoves the Clerk of Works to have a good acquaintance with the proportions of materials, *e.g.* the quantities of ballast, sand and cement required to make, say, a cubic yard of concrete to a specified gauge, or the number of slates to cover a certain area of roof, etc., etc.

Substitutes and adulterants of materials must be known, and the Clerk of Works should be able to recognize and test to find them.

The second item of the technical qualifications mentioned is a knowledge of construction.

The construction to be put into the building is shown on the contract drawings and details, and is further described in the specification and quantities, so that there is always a sufficient guide for the Clerk of Works to follow. His first requirement is to be able to readily read and understand plans, an acquirement which results from the constant study of plans and practical experience, and also from the preparation of working drawings.

These last every aspirant for the post of Clerk of Works should be able to prepare, as in a job of fair size it is manifestly impossible for the architect to provide details of all parts of the construction, and such parts of the work as are not readily understandable by the contractor's foreman, the Clerk of Works must prepare working drawings for, unless the work is sufficiently important to warrant his asking the architect to furnish details of it : and here it must be mentioned that the Clerk of Works is in no way to usurp the architect's work or to trespass on the preserves of the draughtsmen by *designing* mouldings or work of architectural appearance; but he must confine himself to working drawings of *construction* only for work already shown on the small scale plans, etc., and mentioned in the specification and quantities, both of these last forming a guide to him in the preparation of his drawings.

His knowledge of construction should have been practically acquired by having worked on buildings during their erection: he should then know the proper method of jointing, bonding, etc., and also be able to form an accurate opinion as to the length of time work may take to execute in day work.

It is very advantageous—if not essential—that, in addition to his practical knowledge of construction, he should know the theory of construction also; *e.g.* suppose a slated roof is specified, and this is afterwards varied to be a tiled one, it is as well if the Clerk of Works can determine the increase of stresses in the roof members and determine if the sizes require increasing also.

Not only must he know good construction, but he must know bad construction when he meets it. He should also know the common tricks and scamping methods of unscrupulous builders, designing foremen, and inferior mechanics. He must also have a knowledge of tools, plant, and scaffolding.

Good work cannot be done with bad tools, nor yet with poor or insufficient plant, and the scaffolding must be such as will allow of the best work being done, and also every part of the work being inspected as it proceeds. On day work he should see that modern or improved tools are used, particularly in joinery work, otherwise the time charged will be too much. He will also see that only good mechanics are employed. His own experience will assist him in forming an opinion on the workmen engaged.

Quantity surveying is mentioned as the third technical qualification for the post in question. It is necessary to know the system and methods of measuring in the various trades. The Clerk of Works can then take full advantage of the copy of the bills of quantities supplied to him as part of the contract documents. From these, if the quantities form part of the contract, he can readily perceive if extra work is incurred.

The fourth qualification mentioned is "Sanitary Science as applied to Buildings." There will be notes in the trades concerned giving points to watch in this part of the work, but the Clerk of Works' knowledge must include the best methods of making joints in various pipes and the detection of inferior work, both from a craftsman's and from a sanitary point of view.

He must, of course, know where trapping and ventilation is required, and finally know how to test the drains, sanitary fittings, and their several wastes and ventilating pipes. It is possible he may be called upon to prepare, on completion of the work, a drainage plan, and to certify that the drains were laid as shown thereon, and that they have been tested by him and found sound and perfect.

The knowledge of the use of the level is a great advantage, and is a saving of time on large jobs, and also often on small jobs for that matter. If detached buildings are being erected, and the levels of one bear a relation to those of the other (say they are to be joined up by a sub-way, or the drains from both are collected into one system), the dumpy level set up between them will check the correctness of the levels of both at one time.

On a small job within the writer's knowledge a level was advantageously employed. The site was limited, with but little room to store materials, and the soil was such as to require close sheet planking on three sides, and shores for adjoining buildings on the other, so that with the struts, shores, and posts it was well nigh impossible to use an ordinary straight edge and spirit level; but the dumpy level overcame all difficulties, and the levels for various parts of the job were easily and accurately obtained.

Selection of applicants.

The nature of the work must, of course, determine the class of man to be employed as a Clerk of Works, and consequently the qualifications he should possess; for example, for an important stone building, one trained as a mason would perhaps make the best overseer, whilst for a building in which timber predominated, as in hammer-beam and open roofs and wooden framed turrets and cupolas, no doubt a carpenter should be selected—but the next chapter will go further into this question of selection of applicants for the position of Clerk of Works, and some brief general hints on superintendence will be given, which may be of use to selected applicants on first appointment.

CHAPTER II

DUTIES, RESPONSIBILITIES, ETC.

THE moral and technical qualifications have been described, but the successful Clerk of Works requires to be possessed of other personal characteristics, by which he can make his post and duties pleasant, and his working hours run smoothly. Nothing conduces more to the pleasantness of the post than that the feeling between foreman and Clerk of Works is one of good fellowship, as from the commencement of the work both of them will have to meet each day during the length of the job; so that from the outset the Clerk of Work must appreciate the position of the foreman, remembering that the latter is as important to the contractor as he himself is to the architect, that very few foremen are fools, being generally the picked, trained and tried men of the contractor, and that it is quite possible that the foreman is as "clever" as he is.

The foreman who finds the Clerk of Works "weak" is very apt to try more on with him than with one who is "strong," *i.e.* unhesitating and firm in his decisions, etc. To suggest something not practical, is to lose status in the eyes of the foreman at once, and the foreman is generally as capable of sizing up a Clerk of Works as the latter is of forming an opinion on the foreman or workmen.

Who makes the most successful Clerk of Works? The candidates for the position can be reduced down to two classes, viz. the foreman or mechanic, who has worked on buildings in course of erection from start to finish, or, the architect's assistant, draughtsman, pupil, etc., whose training has been mostly in the office. Both may be taken as having the necessary knowledge of the technical subjects mentioned in the previous chapter, but one—the former—has book knowledge, backed up by *practical* experience, whilst the latter has only such knowledge as can be acquired from the study of books, augmented by the preparation of plans, specifications, etc.

Which of these is best able to rise superior to the tricks of the trades, and circumvent them? Which of these two knows best how long work should take to execute? Which of these two is going to work best with the foreman and the workmen?

Surely, in each case, he who has worked with workmen, been one of them, and knows the amount of work that was executed on buildings on which he himself has previously been engaged. He has, or should have, a knowledge of workmen and their ways far above that of a man who has spent his time in a drawing office among a few men of his own class. It is essentially a job for a practical man—a job in which a man with an ounce of practical knowledge is superior to one with a pound of book knowledge only.

The architect's assistant, etc., can and perhaps often has made a capable Clerk of Works, if he has studied construction from the scaffold and workmen when at work, but in the selection between the practical trained mechanic and the indoor-drawing-office trained man, the choice should go to the former.

One of the Clerk of Works' duties is to relieve the architect of unnecessary worry. The sending out of a pupil or architect's assistant to act as Clerk of Works would result in adding to the architect's troubles and worries on the job, as questions of minor importance would be magnified in the eyes of such an unfledged Clerk of Works, and the correspondence between the architect and Clerk of Works of this type would be increased above that which is really necessary; so that if the busy architect has to make the selection of candidate for the post, he will wisely choose the better trained or practical applicant.

Again, of the two classes of candidates, which one is best from the building-owner's point of view? Surely he who is the best judge of work and material, who has himself worked on or beside the materials to be employed, has watched its conditions and peculiarities in all weathers and under practical circumstances, who can push on the work because he knows what workmen *can* do, and who cannot be taken advantage of by unprincipled builders.

Also the gentleman—architect's assistant—Clerk of Works is sometimes apt to over-magnify his position and authority, and this is not likely to help on the work, but rather will tend to hinder the foreman and his workmen. So from the owner's point of view the man with practical experience of work and men is to be chosen.

The aspirant for the post should have made up his mind in the early part of the working portion of his career as to his ambition to be a Clerk of Works, and should all that time have been training himself and endeavouring to acquire the necessary quality of knowledge for the position, the aim of a Clerk of Works' endeavours and his reward being the increase of the size and importance of the buildings entrusted to his superintendence

Duties.

The actual duties of a Clerk of Works are "unwritten," *i.e.* they are not specifically detailed anywhere, though the Royal Institute of British Architects suggest a clause for contracts, but they are generally understood to be the superintendence of the works—the workmanship put in, and the fitness of the materials employed; to direct the construction as to place and method (but in no case to usurp the duties of the builder's foreman); to keep records of all variations—extras and omissions—executed on the architect's written order, and of works in daywork and material, and to keep notes of the dimensions by admeasurement of all work that is hidden or covered up, such as variations on foundations, drains, etc., which are subject to measurement.

Also, as mentioned in the previous chapter, the preparation of working drawings of construction—such drawings to be explanatory only of work shown on the small scale contract drawing. In addition, notes must be kept in a diary of the condition of the job—showing progress or causes of delay, such as the weather or non-delivery of materials. He must keep a list of detail drawings supplied, with their number and description of contents, and dates of receipts. Copies of the weekly reports and day-sheets must also be kept, but more about these will be said later on.

A few general notes on superintendence will now be given. The Clerk of Works will have his office (description will be given in another chapter) in such a position that he can readily see over the job, and he can, if required and the site and construction of the work permits, have it shifted from time to time as circumstances demand; but the fewer changes the better, both for his own comfort and the builder's pocket. And here I would mention that he must not overlook the fact that the contractor is entitled to make a profit: the Clerk of Works is there to see that it is not made at the building owner's expense.

First days on the job.

The first requirement is for the Clerk of Works to check the drawings with the site, as often mistakes are made both as regards dimensions and levels in the survey of the latter. This he should do while the builders are putting up shoring or hoardings, any inaccuracy found in them being reported to the architect and his instructions asked for, so that when the hoardings are completed the work proper can at once be proceeded with.

Any spare time in the first few days can be devoted to making himself acquainted with local bye-laws and the specification clauses, and if he has a copy of the quantities (and these form part of the contract) he can study them, as a knowledge of these will help him in noting extras and omissions and also the method in which the work has been measured.

Another way in which he can employ part of his early days on the work (before the work requires his constant attention) is to make a tracing of the plans on to linen cloth—if his copy of the drawings are not already sub-printed on to linen—as linen plans are much more handy to use than paper ones; they can be folded up and unfolded time after time, and also be put into the pocket.

The work of tracing will help to impress the plans upon his memory and the ability to carry them in his pocket will often save him several journeys to and from his office. Of course, this must only be taken as a useful hint, and, if the work will not allow him time to do the tracing, it must be foregone, as the close superintendence of the work in its earliest stages is of the greatest importance.

Early enquiries should be made locally as to the prices of materials and rates of wages.

One point I would emphasize is the importance of pointing out errors or inferior workmanship and materials as soon as perceived. The practice of allowing builders to proceed with the superincumbent work over parts known to be wrong or inaccurate is not worthy of a man who calls himself a Clerk of Works; he is by such an action lowering the status of the position, which he should be endeavouring by every means in his power to improve. Architects should condemn this practice out of hand; it has, however, been known to occur, but it is only likely to find place with the younger or unprincipled men, who feel big and of importance if work has to be pulled down—by *their* directions.

Hours of duty.

The hours of duty of a Clerk of Works are generally from nine o'clock in the morning until the ordinary leaving off hours of the workmen, and the conscientious Clerk of Works will find plenty to do to fully occupy those hours. Occasionally he can visit the works soon after the starting hour of the men in the morning. These surprise visits may reveal something irregular, or defective work, which would be covered up before his usual hour of attendance. Anything underhand of this sort must be firmly dealt with.

The whole of any inferior work must be pulled down, and the foreman quietly, but firmly, told by the Clerk of Works that in any future similar happening, he would insist on his being removed from the job; for which reason every building contract should contain a clause for "an *approved* foreman to be kept constantly on the works," the architect having full power to require the removal of foreman and workmen if circumstances require such a course to be taken.

Although it has been said that the Clerk of Works should not usurp the foreman's duties, it is quite consistent with his own duties to point out improvements if he can suggest any, either in the management of methods of working, scaffolding, hoisting, storing of material, etc., and every reasonable foreman will welcome such suggestions.

As regards method of hoisting and scaffolding, it *is* part of his duties to see that these are both sufficient and efficient, and also to direct which part of the work is to be proceeded with.

The Clerk of Works should have no direct communication with the workmen. All orders or directions must be given to the foreman. Neither may he treat with the sub-contractors; he must only recognize the main contractor, and inferior work done by the former must be reported to the latter, as he is responsible.

It is necessary for every Clerk of Works to study carefully the plans and sections of his building; every line on a drawing means something, and he should quite early know what that something is. The foreman may come and ask a question and he should be able to give a ready answer, so that it is imperative on his part to keep in front of the work in his study of the plans, etc.

It is not a bad idea to be a floor ahead. This will enable him to find out any small inaccuracies there may be, and also points upon which the plans are not quite clear, and get the architect's instructions or revised drawings before the foreman requires to know anything about that part of the work.

In all his actions the Clerk of Works must try to interpret the architect's wishes and ideas, and the nearer he does so, the more chance he has of earning his approval.

Civility.

In dealing with the builder or the foreman, he must be civil and obliging, but firm in his decision. He must know his own mind, must state it clearly, keep to it, and get what he asks for. By all means he can sympathize with both of them in their mistakes and misfortunes, but he must not let sentiment hinder him in his duty.

Finally, no part of the work is of so little importance as to not require his closest attention and supervision.

CHAPTER III

EXCAVATION AND CONCRETE

Hoardings and demolition.

The hoarding to enclose the site will be one of the first works put in hand by the contractor. For this he will have to pay a licence if it projects at all upon the public footway. If the site is restricted and the space for storing materials is consequently limited, it is as well to obtain as much of the footpath as the local authorities will allow. The erection of the hoarding will be under the supervision of the Borough Surveyor (if it encroaches on the public path), who may require wooden footways, handrails, and fenders for the convenience and protection of pedestrians. The Clerk of Works will also be required to supervise the hoarding, which must be in accordance with the description given in the specification, It should be at least 7ft. high, and composed of close or match-boarding, and if it is described to be kept free from posters, bills, etc., he must see that the foreman has it kept so. Before it is constructed thought must be given as to wicket and draw-in gates.

On a small site in a narrow road it is sometimes advantageous to make the draw-in opposite a window in the new building, the brickwork of which, below the sill, can be left down for a time, making it an arched opening to ground level, which will give a draw-in, and better facilities for the unloading of carts, etc.

In a corner building the draw-in will be, for preference, in the least busy street. The Clerk of Works will require to be provided with a key of the wicket gate for his own use.

In a narrow street, where not much of the pavement can be given up to the contractor for hoarding, it may be found beneficial to put up posts on the kerb and to build up a covered way over the footpath, thus obtaining more space at first floor level. The covered way must be close-boarded, etc., so as to prevent dirty water, dust, etc., from penetrating through and falling on foot passengers below.

If there are buildings on the site to be pulled down, these will be commenced as soon as the hoardings are completed. The Clerk of Works must see to the safety of adjoining buildings. In the actual pulling down, a nuisance from dust can, to a certain extent, be diminished by playing with a hose pipe on the ceilings and plaster partitions before and when demolishing them.

If it is not proposed to allow any of the old bricks to be re-used, all must be removed from the site, but an early inspection of them must be made, so as to allow the foreman or the builder to make arrangements accordingly. If permission is given to re-use them they must be promptly cleaned of all old mortar or compo work, and stacked; but none but whole bricks should be retained on the site, unless for broken brick for concrete or for use as hard dry rubbish.

The Clerk of Works must consider the safety of the workmen during the operations of pulling down the old premises.

Shoring.

The shoring must be of good, sound fir timber. The raker must be notched to fit the under side of the needle, as without this the raker is liable to lateral movement at its head from wind, etc.; and the rakers must be firmly secured to sole pieces with iron dogs, as also must rider shores to those below them. The shores should be levered with a crowbar into their final position. It is usual to incline the sole piece or sole plate at an angle slightly less than 90 degrees, with the raking shore. The foundation to the sole piece must be firm and unyielding. If an angle of 45 degrees can be obtained for the rakers, get it, but often an angle of 60 degrees to 70 degrees has to suffice. All the joints between raker and sole piece, and raker and rider shore must be as perfect as possible.

The shoring is most likely to be an item in the preliminary bill, which the builder will have priced at a lump sum, after his visit to inspect the site. If, however, it is a "provision," in which so many cubic feet of timber are allowed, the Clerk of Works must measure up that actually employed, with the builder's foreman, prior to it being struck.

The Clerk of Works must use his own judgment as to the number of shores required.

Excavation, etc.

The digging operations can now commence. The setting out of the work is no part of the Clerk of Works' duty, but it is important that he checks it, as also must he approve the levels, and, when the bottom is reached, he must note its nature and report same to architect. If it is a good bottom, the other work of concreting it can proceed at once, but, if of an unsatisfactory character, the architect will no doubt inspect it for himself, or give definite instructions upon the matter.

The strutting and planking to basement sides and trenches does not call for much supervision, except to note that the full width of the trenches for concrete is maintained, and that it is safely constructed.

Level or datum marks put in and approved by the Clerk of Works should not be placed on any of the braces or posts of the planking, as these are subject to movement; but some permanent mark, which cannot be altered, moved or tampered with, should be chosen.

The trench bottoms must be rammed, and all loose earth removed. If by an error the trenches have been got out too wide, the extra width must be made up with concrete at the builder's expense; the excavated earth must not be returned.

Close sheeting must be used in the case of a loose or sandy soil, the edges of which must be tongued and grooved or birdsmouth jointed to prevent the sand working through between the boarding. This boarding must be continued down to the bottom of the trench.

If for any reason it is necessary to let the strutting and planking remain in the work, the timber used must be measured up by the Clerk of Works and foreman together, and be brought forward at the completion of the job, when the variations are being adjusted.

It may be necessary in some soils or under certain circumstances to pump water from the trenches, but careful enquiry should be made as to the source from which the water comes, as it may be a natural spring, or some old water course may have been tapped and restarted, in which case pumping alone will probably not be sufficient to get the water away; furthermore, pumping water away may drain the surrounding ground so as to cause settlement of adjoining properties.

If nothing is mentioned as to the need of pumping, or the nature of the soil is not specifically mentioned, or is left to the contractor to ascertain, it is possible the pumping may have to be a daywork extra, but it is usual for architects to have trial holes dug on the site, in order to ascertain the nature of the soil; such holes will also determine if water is likely to be met with, in which case the architect will specify in the contract means of keeping the building dry.

At the same time, on a large site, several different soils may be encountered, in which case the Clerk of Works must keep close notes of these, as to position and depths, etc., and also as to any alteration the architect may direct consequent upon the altered conditions.

As the foundations will be hidden before the adjustment of variations takes place it is of the utmost importance that the hidden work is carefully measured up, or notes kept of the construction put in, so that the surveyors can measure it later on. A specially prepared foundation plan, with sections, is perhaps the best orm for the Clerk of Works to keep a record of the foundation variations. These plans and sections can be signed and agreed to by the foreman on behalf of the builder.

In work in underpinning, the same system of noting the construction put in can obtain.

Under-pinning.

In underpinning the work must be executed in short stretches of about three feet in length, working in alternate bays. All brickwork in underpinning must be in cement mortar, and it is best to carefully measure up the height of the proposed underpinning brickwork, so that the thickness of the joints can be gauged, in order that the top course of this work comes just below the above "whole" work. It is very important that this class of work is not rushed, but that the work as regards bond and the perfect flushing of joints is carried out most thoroughly.

The wedging up can be done with slate or iron wedges, but perhaps the best result is obtained when the "wedging" is effected by the use of good cement mortar, which will give a perfectly even-bearing bed for the superincumbent work, if it is well pushed in and retained.

If the whole of the underpinning is beneath the ground, no brickwork need be used, for the work can then be done entirely in lime or cement concrete.

Concreting.

The concrete for trenches and in underpinning requires the Clerk of Works' most careful supervision. Boxes for measuring the separate quantities of the several materials must be provided by the contractor, and these he must check the dimensions of, and having these boxes he must insist on their being used, and must not allow pails, baskets, and sacks to be substituted on any plausible excuse of the foreman, such as that so many pails are equal to one box, etc.

In the use of the boxes he must see that they are properly filled. He will probably find the foreman inclined to heap up the aggregate box, but particularly careful to strike or smooth off the top of the matrix box: it is a trick of the trade—it must not be allowed—a reasonably exact measure must be insisted on.

As much depends in good concrete upon the quality of the work in mixing and depositing it, as on the use of good materials to form the mass. The result to be arrived at is to obtain one perfect homogeneous mass, free from all voids. The concrete must be mixed on a clean wooden platform, large enough for the one gauging of the materials to be used and to admit of the workmen engaged on mixing it.

If the platform is adjacent to the position in which the broken brick ballast, etc., is stored, scaffold boards must be put between the store of ballast and that actually on the platform forming part of the gauge: this will prevent the workmen shovelling in more material whilst the mixing is being carried out—a very common trick.

The mixing should be done twice whilst the materials are in a dry state, then again turned over twice, whilst water is being added through the rose of a hose-pipe or watering can; none but clean water must be used. A rose to the hose or can should be insisted on. as to use either without one simply ends in a flood of water being directed on to the gauging, which will wash away in a stream the matrix or cementing matter.

The concrete, as soon as mixed, should be put into barrows, etc., quickly, and wheeled as near as possible to the place of deposit, and then gently tipped or lowered into position. It should not be emptied into the trench from a height, as by doing so the heavier or larger particles separate from the lighter or smaller ones, which is to be avoided. The old idea that the falling from a height consolidated the materials is now held to be in fault.

Again, a second objection to this practice is that in falling it may strike against the side of the trenches, causing earth to fall in, and so spoil the concrete, and also there is the waste of the concrete which adheres to the side of the trenches.

Ramming the concrete may be carried out provided that it has not commenced to set, as any disturbance in setting weakens its resulting strength; but if the rammers follow immediately upon the fillers, it is advantageous, and should be continued until the cement-laden water in the concrete rises to the top, when it should be discontinued. The rammers should be proper iron ones, beating the concrete with the back of the shovel is not sufficient.

If the concrete is of good depth, it should be put in in layers of about twelve inches deep, each layer being well rammed and allowed to set before another one is put on, the bottom layer being well watered before the top one is deposited upon it.

If lime concrete is used, it is very important for the Clerk of Works to see that the lime is properly slaked before mixing with the materials forming the mass.

The materials most commonly used as aggregate in foundation concrete are ballast, broken brick or stone, and sometimes burnt ballast. If so many parts of sand are specified, then the ballast must be practically shingle; if no sand is mentioned, the ballast must contain sufficient sand to make, with the cement or lime, a mortar sufficient to fill the voids of the aggregate material.

The ballast must be clean, of various sized stones angular in shape, free from dust, loam and foreign substances, and of the size to pass the specified ring. The broken brick must be from good hard bricks or bats that have been cleaned of old mortar, and none from the flues of old buildings and coated with soot may be used.

It must be broken to the required ring and screened from dust. It is advisable to wet well the broken brick and stone prior to adding the usual water when mixing, to prevent it absorbing the water required for perfect mixing.

The notes given on sand and Portland cement in the next chapter on Bricklayer, apply equally to sand used as a concreting material.

CHAPTER IV

BRICKLAYER

Tests for bricks, sand, etc.

Before any brickwork can be executed, the quality of the materials to be used by the bricklayers must be looked to. The specification clauses relating to this matter may be specific, in which case the Clerk of Works has but to see that he gets those asked for; but if choice is left to the builder as regards the internal or backing bricks (the facing ones are sure to be described), there is certain to be some description given in the specification to assist the Clerk of Works in approving those submitted to him.

The points to guide him in selecting a brick for use are:—First, the size and thickness, as it must bond in with other varieties to be used on the same building; secondly, can the supply from the brickworks be so constant as to preclude all chances of stoppage of the work for the delivery of bricks?

To choose a brick that is as near perfect as possible in form, shape, size, etc., but of which the supply is limited, would be absurd. The bricks chosen should consist of well-burnt ones, regular in shape, without cracks or flaws, and with good arrises. There should be but very few bats resulting from a tipped-up cart load, and these, where not required for bond, can be used as hard brick rubbish or dry filling.

Then again, the nature of the work must be considered. For ordinary work, bricks should be porous to a certain extent. A brick which will absorb one-sixth of its own weight is a fair brick for this purpose; those which absorb more, say one-fifth, are probably too underburnt.

Now, for heavy or engineering work, a close, dense, heavy brick is required, and consequently such bricks have to be burnt at a higher temperature, and the result is a brick of less porosity, and one to which mortar will not so easily adhere.

Too much reliance must not be placed upon the sample brick submitted by contractors for approval, as it is very likely to be a picked one; it is much better for the Clerk of Works to inspect the stacks which it is proposed to supply from.

He can then better form an opinion as to the ability of the brick merchant to keep up to the sample in all respects. If, however, the sample is from a works at some distance from the job, he should then insist upon the builder guaranteeing that those supplied will be equal to the sample always; in fact, the Clerk of Works should inform him of this condition before the sample is submitted.

The Clerk of Works must be as strict about the quality of the bricks towards the middle or the end of the job as he is at the commencement, as it is no uncommon practice for a builder to supply different bricks to those approved (even sometimes from different localities, let alone makers) as the job goes on, particularly so if he find the Clerk of Works not very observant of small matters.

As regards the facing bricks, he must look for at least one good face to every brick, with true arrises, and insist from the outset in having every badly spalled facing brick laid in the work cut out as soon as noticed.

The sand will also require approving, and if the pit is near at hand the Clerk of Works must most certainly inspect it, when he can see for himself its quality before any is delivered. The sand should be sharp, and of an angular grain, and to obtain this pit sand must be chosen instead of river sand; it should also be clean, though most pit sands are stained by ochres.

The sharpness can be noted by working it between the fingers and thumb; its shape can be seen probably by the eye, and can be proved by a glass of slight magnifying power; its cleanness can be ascertained by rubbing it with the fingers, but the true sense in which it should be clean is that it should be free from loam or earthy matters, and from foreign substances, and where a sand is not naturally so it must be washed. The size of the grain should not be too small, but yet should not be over-large, so that the mortar joints are thickened.

In no case should sea sand be allowed to be used, on account of the salt it contains, and which is difficult to remove, even with many washings.

If no sand is procurable, except at some considerable distance, substitutes for it may be suggested and submitted, such as burnt ballast, engine ashes, clinker, etc. The Clerk of Works must in this case make a thorough inspection of that proposed, and find out the source of the slag or clinker, and then report same to the architect for his decision as to allowing its use.

Tests for Cement, etc.

The lime and cement for making mortars must be carefully chosen, especially the former. As regards the latter the specification may merely state that it is to pass the British Standard Specification, 1907, and most firms will supply and guarantee this; but at the same time, there is no reason why the Clerk of Works should not roughly test same for himself by any methods known to him, or, if he is provided with a testing machine, he can make tests of each consignment as delivered.

Some of the rough tests he can employ are, say for fitness for use, thrusting the arm into the cement; if it remains at blood heat it is in fair condition for use, but if it gets cold, it is probably dead or inert, whilst if the heat increases it is likely to be too hot for immediate use. This is, of course, a very rough test.

Others are to make a paste up of the cement to be tested, and to put same into a glass bottle and let it set.

If the cement contracts, this can be seen by its becoming loose in the bottle, and a little coloured water poured in will at once betray it; on the other hand, if it expands it may crack the bottle. Or a small part of paste cement can be placed on a piece of glass or slate, and smoothed down to a fine outer edge. When the cement has set the edges should still remain uncracked.

These are but a few simple tests which can be used alone or in conjunction with a proper testing machine. It is not everyone who can use a machine. The actual testing part is easy enough, but it is necessary to have experience in filling the moulds to make the briquettes. I have seen briquettes from the same sample yield widely different results under test when some were made by an experienced man, and others by one with little or no practice in filling the moulds.

At the same time, it is not wise to accept as gospel the statements of cement manufacturers' test pamphlets sometimes issued, but some tests should be made independently at intervals, though if the cement is obtained from a reputable manufacturer with a guarantee that it will stand the specification test asked for, it can safely be used. Under certain conditions it may be necessary for the architect to specify a stensile stress per square inch far exceeding that asked for by the British Specification, 1907, in which case tests should most certainly be made of each consignment delivered.

Mortar.

The lime may be specified as to where it is to be obtained from. When this is so, the Clerk of Works has but to see that he gets it. If, however, it is left to him to approve, he must see that he obtains a lime of the description demanded. The Clerk of Works should know the phenomena which follows the slaking of lime, and also its setting qualities, in order to be able to judge to which class the lime under observation belongs. This knowledge is part of the subject of materials which forms one of his qualifications for the post, so that it is unnecessary to enlarge upon the matter here.

The mixing of the mortar in its proper proportions is of first importance. These will be fully described in the specification. He will see that the gauge boxes are brought into use, and that they are properly filled. As regards the lime, he must see that it is properly slaked, so that it does not slake in the work; also that the mixing is properly performed.

For a large job mill-made mortar will probably be used. If so, he must see that it is not over-ground. Such unapproved substitutes for sand as broken brick or stone must not be put in the mill: they are very apt to be when his back is turned.

For cement or the more highly hydraulic lime mortars, it is of paramount importance that only so much is made up at a time as can be immediately used. On no account whatever may it be knocked up again for re-use, for which purpose it is usual to specify it "as not to be used when once set, or when it has been made for more than an hour." These are points the Clerk of Works is there to see carried out.

Generally the Clerk of Works will see that the materials used by the bricklayer answer the specification clauses in all respects, and that no foreign matters are allowed to be added to, or fall into, the mortars when once made. He should know a good mortar when he sees it by the way it works: there should not be an abundance of water with it, and he must take no notice of the grumbles of bricklayers that it is too stiff, etc., to use, which means, probably, it is more wrist-aching for them than it would be if it were nearer the consistency of "larry," which all lazy men prefer.

He must also see that in hot weather, and when required, the bricks are wetted to prevent them absorbing too readily the water from the mortar.

The work of bricklaying commences as soon as the concrete in the trenches is set and hard enough to lay on. As before, the Clerk of Works will not set out the work, but will carefully check the foreman's setting out.

If the concrete has been properly put in and levelled, there will be no need for cut courses to commence with; there should be no need to mention this, but from experience I find that occasionally courses are cut, owing to the top surface of the concrete being more or less a miniature switchback, the hollows of which have to be filled in either by a thick bed of mortar or a cut course of bricks; both are objectionable, the latter being the lesser evil of the two, but every Clerk of Works should see that neither are necessary.

Footings.

The first few courses of brickwork form the footings to the wall usually, though in some parts of the North of England and in Scotland they omit these altogether, but, as they usually thicken the bed of concrete, it is doubtful whether the omission is a saving or not. One reason against the adoption of this construction is that in designing it is against the general principles to have a sudden change of form, and by making use of footings you are gradually changing the construction form and also gradually spreading the weight of the wall over a larger area.

If you have walls on the boundary of the property, there cannot be footings on both sides of the wall, and care must be taken to see that this boundary line is correctly determined and built upon. In building the footings of such walls it is sometimes the practice to step them as sharply as possible, often having 1½ inch projection instead of the usual 2¼ inch. As such walls have a tendency to tilt outwards, often a knee of concrete about 9 inches by 9 inches is placed under the ordinary concrete on the outside edge, that is the boundary side.

The Clerk of Works will see what the specification and drawings demand. He cannot ask for these "improvements" unless they are clearly specified.

Bond.

It is expected of the Clerk of Works that he knows good bond, and he must see that he gets it everywhere. For footings, headers are mostly employed, and bats and half-bricks are only to be used when absolutely necessary to bond. He will see that the foreman does not improvise a bond, enabling him to use them up, or one to which the bricklayers can lay more bricks quickly than in that bond which is specified. If nothing is stated as to bond, the Clerk of Works will insist on English throughout for all internal and stucco or cement rendered external walls, and if the "faced" walls are not described as to be in Flemish bond, he can wisely ask the architect if English bond will not do also for these.

The architect may have given some thought to the question of bond in sizing his window openings, and that the piers are of dimensions that permit of true bond being maintained.

The Clerk of Works will pay particular attention to this bond between such piers and openings. especially on "faced" walls, as though "broken bond" is necessary in places it should be put in in the most convenient position, having regard to appearance and strength.

Joints and perpends.

Solid work is of great importance, and the Clerk of Works will therefore see that the joints are properly flushed up, and not just a layer of mortar spread over the top of the course, ready for the next above it; for the vertical joints should be as well filled up with mortar as the horizontal ones. If the horizontal mortar joint is a thin one, and the bricks being used have a large frog, it is very necessary to see that that sinking is also filled up. This particularly is so when the bricks have a frog on both sides, when the under ones, when laid, should be thoroughly solid with mortar; if a difficulty is experienced in getting the bricklayers to do this, the foreman must be instructed to have the frog filled in independently before the brick is laid on the course.

Another important point is that the walls round the building are kept truly level. Often they are found at places to be out of level, and then cut courses or brick on edge ones are inserted. This will ruin the bond and must not be allowed, but rather the work should be pulled down to a point where true or level work exists.

Equally important is the keeping of walls truly perpendicular, no bellying or hollowness existing on any wall. If quoins and openings are plumbed the work in between should be plumb as well, but often different men work on the same wall, some being removed to other work on the same job, when it is no uncommon thing to find that the change of men will result in a wall being built out of perpendicular, some working tight and others slack to the line, for which reason men should be taken away from the work as little as possible.

Not only must the face of the walls be perpendicular, but the perpends must also be kept in a like condition. Nothing looks worse on a "faced" wall than that the vertical courses of alternate courses follow a zig-zag course from top to bottom of the building. True perpends denote good work, and can only be obtained by using bricks of one length and width; or, if they are of varying length, by the careful choice of them by the bricklayer responsible.

On walls faced with superior bricks, such as "reds," their appearance is often spoiled by the splashes from the scaffold board nearest the wall, during rainy days. At nights, or on occasions when work is left owing to the wet weather, these front boards should always be turned up to avoid such splashing.

All walls should be brought up to the same level at one time; this avoids racking back, which, besides tending to get walls out of level, allows of a weakened joint at the point of joining up afterwards. If walls must for some unavoidable reason be left down, a window or door opening should be chosen as a leaving-off place, and in no case should one wall be raised above another higher than one scaffold, or 5 ft. high.

The work of cutting, toothing and bonding new work to old, or of picking up properly left toothings on old buildings, must always be done in cement mortar, as the new work is liable to sinking or settlement, whilst the old is firmly established.

In wet or frosty weather walls should be covered up on top by sacking, straw, etc., and no work should be resumed until the frost has gone entirely out of the work, and any work affected in the least should be taken down and rebuilt.

Protection of work.

The formation and building of flues for chimneys requires close attention. A good bond must be obtained, and where 4½ in. work is concerned, Flemish bond is the most effectual to this end. The withes should be properly flushed, and the flues should be pargetted as they are carried up, the pargetting or parging being a mixture of lime mortar and cow-dung; and as the object of this parging is to prevent an accumulation of the soot in the joints of the brickwork, it is important that it should be finished off smoothly.

Flues.

Often a 1 in. fireclay lining is substituted for this parging, in which case particular attention must be paid to the jointing. All flues should be cored as the work proceeds, to prevent mortar dropping on to the lining of the flue, and forming an obstruction and a projection for soot to accumulate on.

No interior angle of less than 130 degrees should be formed in a flue, unless a proper soot door and frame is built in to provide a means of getting at it for periodical cleaning. The Clerk of Works will see that no timber is fixed closer than nine inches from the flue of any chimney.

Work executed in glazed bricks requires close attention. Samples should be submitted to the Clerk of Works by the builder, and he must see that they are of the quality demanded by the specification. It is no uncommon happening to find a consignment will vary in colour, but it must be carefully gone over, and the approved tint colour only be used, as nothing looks worse than to have a glazed brick wall of varying shades.

Glazed and other brickwork.

The previous remarks as regards the keeping of the perpends and horizontal joints true applies equally to glazed brickwork. In selecting a sample, it must be seen that the thickness is of a correct size to bond in with the remainder of the brickwork.

Glazed bricks are much more costly than ordinary bricks, and it is on this class of work that the scheming foreman or builder will try to cut his headers in half. As most glazed bricks have a frog on both sides, the previous note as to filling up of these must be watched.

All cement or mortar splashings must be cleaned off the bricks at once ; it is much easier to remove them whilst wet than when they have set or got hard, when there is the risk of chipping off the glaze as well.

It must be seen that arches and lintels really act as such, and, in the case of the former, that they are truly shaped. In no case should centering be struck until the arch or lintel is firmly set or bedded, and the latter, if made of coke breeze and reinforced by steelwork, should be made independent of the work in moulds, and be hoisted and fixed only when quite set, for which purpose they should be made three weeks before they are required for use, but often the foreman will try to make one mould answer for several lintels at the same level ; this must not be allowed.

It is important that the Clerk of Works sees that chases are left in the walls to receive the edges of the concrete floors and landings where shown, or that corbelling is provided so as to prevent the cutting out of bricks after the work is up.

The scaffolding must at all times and in all places be such as will permit of the men doing best work. Overhand work should never be allowed when it is at all possible to provide a scaffold on both sides of the wall ; and also the scaffold must allow of the Clerk of Works inspecting every part of the work, for which reason no boards should be allowed to be removed to the higher ledgers until the whole of the work executed at that level has been inspected and approved of. The scaffold must be wide enough for the men to work on, and in no position should the Clerk of Works agree to inspect work when only a one- or two-board wide run is provided. Guard boards must be provided on the outside edge to prevent materials falling on to the lower levels.

All arrises of quoins in piers or openings should be protected by wooden covers, as also plinths, copings, cornices, and projections generally, and the Clerk of Works must see that their use is maintained until the scaffold above them is struck.

In hollow walls look to the proper number of ties being used, and that the ties are of an approved shape and weight. The cavity must be left clear of rubbish.

Work with firebricks should be set in fireclay, and when the stoves and ranges are being set he will see they are securely fixed and proper flues formed.

The pointing of walls must be properly executed, and the Clerk of Works will decide whether it can be done as the work proceeds, or if it must be left until more favourable weather obtains. In the summer months there is rarely any need to leave it, but in the winter, especially if there is the least suspicion of frost, it is best left until the scaffolding is being struck, when the stone work can be cleaned of its slurry and the whole work can be brought cleanly down from top to bottom.

Care should be taken to see that the joints of the brickwork are raked out sufficiently deep, and that in raking them out the arrises of the bricks are not damaged.

There are a number of small items that call for the Clerk of Work's attention, such as seeing that the perforations or openings for air bricks are rendered smooth; that chimney bars are of the correct width and thickness specified, and are properly turned up and down at the ends; that damp courses of slate are laid double and to break joint, and are pointed up at the outside edges in cement, and that the slates used are of a good quality; that circular work is to the correct radius, and that radiating bricks are used if specified; that in hot weather the bricks are wetted; and generally that everything executed is built in the most approved methods to ensure good results.

On the completion of the work it may be found that there is an afflorescence on the brickwork. This will detract from the appearance of the work, and the Clerk of Works may wish to endeavour to remove it. It may disappear in time as rains carry away the salts from the work, but often it can be removed by scrubbing the face of the work with diluted hydrochloric acid 1–5, previously well wetting the brickwork affected, and afterwards removing all traces of the acid by thoroughly washing the work with clean water.

CHAPTER V

SUPERVISION OF MASONRY

Conversion, delivery and approval.

WITHOUT doubt the best man to act as Clerk of Works on a large work with stone walls or ashlar facing is a mason—a man who has himself handled stone, worked on it at a banker, and consequently had first-class opportunities of obtaining a knowledge of faking and stopping. He will know where to look for it, and be in consequence better able to detect it. However, a man not a mason by trade can successfully act as Clerk of Works, if he has a knowledge of the nature, properties, and characteristics and general working of stones, and sees that he obtains a good knowledge of the particular stone specified for his job, during the earlier stages of the work, before any stonework is required on the site. This he can best obtain by visiting the quarries in the neighbourhood from which the stone is to come.

If the specification demands that the stone is to be worked on the site, he will be very fortunate, as close supervision will prevent errors and opportunities for covering up bad material and workmanship. One advantage of working the blocks on the site is that the many unavoidable points which crop up when the work is in hand can be gone into immediately on the spot by the foreman and Clerk of Works, instead of having to endeavour to explain in writing by letter to the quarry, which is never so satisfactory as a conference in person.

If the site is limited, the stone may be worked in the builder's yard, to which the Clerk of Works should pay frequent visits to inspect the stone in conversion. If the stone used is from a quarry in the neighbourhood of the job there is not much objection to it being worked at the quarry, for the Clerk of Works can as easily visit there as at the builder's yard.

In every case the stone should be delivered and fixed in a clean condition, as it is only by this means that proper supervision of workmanship can be obtained. The practice of slurrying over the stone before delivery must be condemned at once; there is no reason for such a custom—except to cover or hide up some stopping or badly worked or rubbed work. The stone being clean, the Clerk of Works can at once see if the arrises are true, the section of correct shape, the beds and joints worked properly and not hollowed out, and that blocks are free from veins, blotches, stains, etc.

It is possible that the jointing will not all be shown on the drawings and details, in which case their approval rests with the Clerk of Works, unless the architect has expressed a wish to see the setting out of these before the work is put in band. The length of a stone should not be too great in proportion to its width and depth. No stones, except those of great transverse strength, should have a length greater than three times the depth. In stones of greater strength the length may be from four to five times the depth.

The contractors or the quarry merchant will prepare drawings of all the elevations showing the proposed jointing, and these, when approved, answer for the fixing plan. Each stone should be numbered; all to one template can be of one number, and each course from top to bottom can be lettered.

The Clerk of Works can be furnished week by week by the foreman with a list giving the identity letters and numbers of the blocks of stone that have been delivered, so that the Clerk of Works can mark on his copy of the fixing plan the actual stones on the job, and if he puts a date against each, he can see at a glance which stones are required to get the work up to a certain level, and so have a record giving reasons of delay from non-delivery or rejection of the stone blocks, which notes may be of great use in the event of the contractor exceeding the time limit of the contract, when the architect may call for explanations or reasons of delay.

The Clerk of Works will decide upon the position the stone is to be placed in, when delivered, before it is fixed in the work. The place chosen should be under cover, if possible, and such that no bricks, etc., can fall upon it and damage its arrises and surfaces,

The rejection of a block of stone means in most instances delay to the job whilst it is being replaced; thus careful handling of the stone is essential. It is no uncommon occurrence to find on a job of fair size that more stone is damaged whilst on the job, *i.e.* after delivery, than in conversion and actual delivery. There may be time to replace a stone rejected at the time of delivery before it is required for fixing, and any stone badly worked, rubbed hollow, short in its length, spalled and of damaged arrises, should be at once rejected. If it is damaged in hoisting or fixing or since delivery, its rejection at these times often means considerable delay, and the Clerk of Works must determine if the damage is sufficient to warrant that delay.

It is best to view with suspicion any stone, at any height in the wall, that has had a piece let in or made up with white shellac and stone dust, but in some cases the position of the filling may be of not sufficient prominence to reject it, if serious delay is likely to be occasioned by such rejection. In the case of such a stone its position and purpose must be considered, and if it is for an important situation, and it is not possible to rework it on another face, and make up the reduced contents with the brick backing, the stone should be rejected right out.

A stone refused because of its inferior quality must be broken up or removed from the site—preferably the former, unless it is kept on the job so as to ensure it is not reworked up for a smaller block.

Hoisting, setting, and protection.

No stone, as a rule, should exceed three hundredweight in weight, as above that size blocks are more difficult to handle, hoist and set, but there are some circumstances in which stones must exceed that weight. The means of hoisting must be approved by the Clerk of Works, in order to ensure the safety of the workmen and to avoid delay from replacement of damaged stone. The stone should be hoisted to as near the position it is to occupy in the work as is possible.

The Clerk of Works must watch the insertion of lewis holes, etc., that they are made in a part of a surface that is covered by the bed of the course above, or in the case of a cornice where lead covering is to be provided. The whole side of the lewis should press against the stone and not merely the outer edge of the hole. He must also note that holes for rag bolts, etc., are put in their exact position and are of the proper depth and shape.

Large stones are generally lowered and tried on their beds before setting; they are then again raised, and the bed of mortar or putty spread, the bed having previously been well wetted. The stone is then finally lowered on to wedges, so that when these are taken out, the stone rests on its exact bed, when it is well driven home on its bed by the masons with their mallets.

All projecting cornices and overhanging stone courses must be strutted up until the work is tied down at the back, and the Clerk of Works must see that provision is made for the tying or holding down of the top cornices, etc.

The men actually setting the stone should be masons, and in no case should bricklayers be allowed to set it.

The Clerk of Works will see that the beds are worked truly level, and are not hollow in the centre of the bed, as that would throw the weight on to the outside edges, which would fracture or spall off. The faces exposed, if to be finished rubbed, should be as smooth as the surface of the stone will allow, and the surface should be one true plane, and not a series of sinkings and ridges as is often the case. It must also be out of winding. The joints to be used will be specified, and the Clerk of Works will see that the correct joggles, dowels, and cramps are put in.

He will see that the line of one quoin cuts in with another, and that all throating is done before the stone is fixed, as it is more difficult to execute this labour after fixing than before.

Iron dowels and cramps are under no circumstances to be used unless galvanised In the double V grooved and pebble cement joints he must see that the V groove in each stone accurately meets when the two stones are placed together, and that the stones to be joined should be well watered prior to running with cement and sand in the joint, to prevent the dry stone absorbing all the moisture from the jointing material.

The specification or detail drawings will determine the size or fineness of the beds and joints, and also the finish of both. Neat arrises are necessary in every kind of finish.

Ample protection must be given to the blocks of stone after delivery, to protect them from wet and frost, as the moisture absorbed may freeze, expand, and burst the stone subsequently. Similarly, all executed work must be protected by straw, sacks, felt, boards, etc. All projecting strings, cornices, bands, sills, jambs, etc. must be protected from damage by wooden casings as soon as fixed.

The specification with most stones will be sure to ask that the stone is to be placed on its natural bed., *i.e.* the bed of the block is to be that which was its original in the quarry. In some stones the "bed" can be easily seen; in others it is difficult to discern. In some cases to wet the stone may help to determine its natural bed —it being occasionally more easily noticeable when in a wet condition. In some stones it is denoted by the lines of lamination; in others, as in Portland, by the arrangement or disposition of the shells which are present in the stone.

A stone placed on its natural bed will bear more weight under compression than when placed with its natural bed perpendicular. To place a stone of a laminated nature with its natural bed vertical would allow the stone to scale or peel off in layers.

Any stones, such as cornices, undercut mouldings, or large projecting string courses, which are placed with their natural bed vertical, should be covered with sheet lead secured with lead dots, in order to prevent rain, etc., finding its way into the layers of the stone.

The stone for the staircases and steps will be specified.

Staircases.

Most York and other hard stones permit of smooth rubbing and good arrises, and the Clerk of Works must see that the work supplied is of the quality of finish demanded. In no circumstances whatever should the Clerk of Works set out the stairs or give dimensions, but, of course, he must check them. The soffits of all steps of spandrel shape should follow one line, and any steps which do not do so must be rejected. Spandrel or splayed soffit steps must have square wall-holds.

The joggles to landings must be neatly executed. All steps and arrises of landings must be promptly protected. The holes for iron balusters must be exactly cut; this is an item of labour that is frequently spoilt by workmen using poor tools. It is quite a common occurrence for the delivery of the stone steps to be late, but this can be to some extent obviated by the Clerk of Works insisting on the order being placed in good time.

Stone steps are best built and pinned in with slate and cement, but often, rather than have delay, pockets can be left for them and bricks in sand inserted, but it is best to avoid this necessity. It is, however, necessary to see that the work above and below the stairs is in cement mortar, so as to avoid the work settling to the detriment of the stairs.

The hanging ends of steps must be supported from a solid foundation until quite set.

For the remaining kinds of stone, such as for templates, coverstones, etc., the approval will probably rest with the Clerk of Works, to whom the builder will submit samples. The stone selected should be of a very hard description, free from laminations, vents, flaws, etc. In unplastered walls, templates, etc., should be rubbed or tooled on their exposed faces as described, and it is important that they should be ordered of the exact dimensions, as the actual work of the piers, etc., may not work out exactly at the width shown on the drawings for the templates.

Granite.

If any granite is required for the work, this is sure to be delivered already worked by the quarry people, who have every facility for working it. As it is an expensive material to make alterations on, the setting out should be carefully checked by the Clerk of Works, and if the granite forms a base to the building and any of the frontages are on sloping ground, it is very essential that the falls of the roadway or ground line shown on the drawings are correct with the actual condition of things.

Cleaning down.

It has been mentioned that the stone should be delivered clean—that is, without slurry, for the reasons given; but when set in the work it is often the custom to slurry the work with a very weak mortar, and it has the advantage of keeping the weather from the face of the stone, so that after the cleaning down and striking of the scaffold the whole of the stone on the building is of one tint, instead of the lower part, *i.e.* the first-built portion, being darker in colour by its exposure to wind, rain, soot, dust, etc. The architect may not wish the slurrying done, when, of course, the Clerk of Works must see that his wish is observed. In no case must the scaffold be lowered from one level to another until the Clerk of Works has inspected the work at that level, and he must see that in the cleaning down no damage is done to arrises.

The Clerk of Works will see that a properly constructed masons' scaffold is provided.

He cannot be too careful in his notes of the masons' work of the job. Information must be kept of thickness of beds, number of joints, dowels, etc., in the case of variations; and of dates of delivery of the stone and of fixing at various levels in case of delay and its consequent explanation.

Restoration work.

If the work includes the restoration of portions of old stone buildings, every care must be taken in the selection of stone and of the workmen to work on it. If the removal of plaster reveals old masonry, etc., it must be seen that in no case is the stone of the wall disturbed, and if there is discovered any colouring on the stone the plastering must be removed so as to leave the colouring intact as far as possible, for which purpose it is wise to insist that no chisel or punch shall touch the stonework. At the same time lime-whiting or colour-wash on plastering should be carefully washed off in case old design or colouring is found beneath the lime coating.

Every part of the old wall taken down should be roughly sketched into a sketching book (mentioning the position it occupied) and be numbered, and a duplicate of the number be attached to the stonework in such a way as not to injure the fabric.

In restoring old moulded work, be particular in seeing that the accurate section is used. Search must be made for the true members in the parts of similar work which are best or most protected from rain and winds.

Generally on restoration work, as each piece of old work is discovered, the work round it should be left severely alone, until the architect has an opportunity of personally inspecting it.

CHAPTER VI

SUPERVISION OF DRAINS

Contractor's responsibility.

THE supervision of drain work cannot be too conscientiously carried out, as when the work is completed and covered in, all defects are buried, and to remedy a defect then is a costly matter. It is, however, usual for the conditions of contract and specification clauses to make the contractor responsible for the soundness of the drains right up to the completion of the building, and one of the last duties of a Clerk of Works consequently is to re-test the drains.

There is only one quality of workmanship that can be passed, and that is the very best obtainable, and in testing, no defect, however small, must be overlooked—the result of the test must be perfection in soundness of the joints.

Approval of materials.

To do the best work, best materials are essential. The specification will state the kind of pipes to be used. They may be of clayware or of iron, but no matter of what material they are to be, the pipes themselves call for close inspection, and, in the case of clayware ones, samples should certainly be submitted to the Clerk of Works, and those delivered must always be up to the sample. The sample pipe should be straight, of even thickness, and the pipe with its socket must have been made in one operation, in one mould; it must be well glazed, be free from cracks, flaws, and be perfectly smooth inside, and the 2-inch socket must be of perfect form.

A rough test of the pipe can be made by cutting a piece of stout slate to fit the socket end of the pipe, and cementing it well in, and when thoroughly set the pipe can be stood upright on its socket end and filled with water. The water-line can be marked by means of a piece of stamp edging paper on the inside of the pipe. The water-line should not in twenty-four hours sink in the pipe, nor yet should sweating appear on the outside of the pipe if it is one at all worth accepting as fit for the conveyance of sewage.

When one thinks that such conditions may actually at some time obtain on a job, caused by a blockage which may fill some of the pipes full bore for a period oftentimes exceeding twenty-four hours, this test cannot be looked upon as excessive.

Of the clayware pipes, only stoneware ones will answer this test, and the best of these come from Poole district. They are practically non-absorbent even when unglazed. They are, however, more difficult to cut than earthenware and fireclay ones, being brittle and liable to split in a careless workman's hands.

The fireclay pipes are both more porous and weaker than stoneware ones, but are more easily and neatly cut than the latter, but rely on the glazing or enamelling for their being able to resist sweating.

Earthenware pipes, of course, are not fit for foul drainage work of any description.

Some stoneware pipes are marked T for "tested" on the spigot end, and if the specification demands pipes of such quality they must be used. The testing consists of subjecting them to a pressure of 50 lbs. before leaving the manufacturer's works. The letter T must be stencilled on, and not branded in, as it could only be so branded whilst the pipes were not in a condition to be tested.

Some firms' ordinary pipes are almost equal to other firms' tested ones, so that the Clerk of Works had better make his own test of a sample, and form his own opinion as to the quality of the pipe submitted.

The larger manufacturers of Devon and Dorset stoneware salt glazed pipes place a black band round a defective or damaged pipe at about 6 inches from the socket. Such pipes must not, of course, be permitted upon the site under any consideration.

With the present stoneware socketted pipes there is a possibility of the spigot end of one pipe not centering the socket of the lower one, and this is a certain cause of much of the bad drainage work now executed with such pipes. The Clerk of Works must see that this centering of the spigot in the socket is effected.

To overcome this difficulty the Standardization Committee of the Institute of the Municipal and County Engineers have recommended a new style of socket, to which the spigot end of the next pipe must more accurately centre itself, and the possibility of careless workmen forming lips in the inverts of the pipes is to a great extent done away with. The Clerk of Works must see that the pipes are laid without such lips.

The iron pipes must be of the weight specified, and the sockets must be of sufficient depth, width. and strength to make a good joint. These also must be true in length and shape, and the bead on the spigot end must be a bead and not just a burr.

Checking of plans.

The first duty of the Clerk of Works, when dealing with the drainage part of the contract, is to look well into the proposed plan, to see that provision is made to pick up every sanitary fitting waste and R.W. pipe, that through ventilation is provided, and that the ventilation outlets are in the best positions. The depth of the sewer should be ascertained from the borough council surveyor's department.

It is not an unheard-of occurrence to find no sewer exists in the position shown for the drains to enter into. He must see that all wastes from basement fittings can be got into the drain. If the basement is lower than the sewer, some sort of ejector must be provided.

All drains must be disconnected from the sewer by means of an approved disconnecting trap, which must be provided with a raking or clearing arm which is sealed off, having at the manhole end a means of unsealing in the event of the trap getting blocked and the manhole becoming filled.

In order to avoid the need of actually reaching the raking arm to remove the seal, a brass seating and lever stopper should be provided, with a galvanised iron chain up to the top of the manhole, at which point its end can be conveniently hung up on a special hook for this purpose.

Laying of drains.

The drains must be laid to a true gradient, and also be in a perfectly straight line laterally; a switchback foundation and a twisting line on plan are two evidences of careless workmanship and supervision. This true gradient is best obtained by means of sight rails and a boning rod. The sight rails consist of two vertical posts and a cross or horizontal member. Each post is conveniently placed in a drain pipe stood on its socket end—one on either side of the drain trench, the space round the post being filled in with sand or rammed clay. The drain pipes for these posts *must* stand on solid ground.

One set of sight rails is placed at either end of the trench for the drain, and the sight rails are so placed as to represent an imaginary line parallel to the proposed invert of the drain pipes, or in other words, the difference in level between the top edges of the sight rails is the fall required in the drain between them. The upper edge of the sight rails should be chalked or painted to make them easily discernible at a distance.

The boning rod consists of a T-shaped frame, of the exact length or height from the top edge of the sighting rail to the invert of the drain pipe. The bottom edge of the rod should be fitted with an iron flange, to go beyond the socket of the pipe, and lay for some inches on the invert of the barrel of the pipe. When the rod is held *upright* in any one laid pipe, the top edge of the rail forming the T of the rod should bone through with the above-described sighting rails.

When sighting over the rails, the trueness of the pipes laterally can be seen, and the workmen can be directed to move them to the right or left as required. If the trench is of a good length, intermediate sight rails must be provided.

The top edge of the first sight rail should be levelled on to some undisturbable object, such as a wall, so that it can be noted from time to time if it has shifted in any way.

This explanation of the use of sight rails is somewhat lengthy, but I find that they are not used where they could be, and their use is certainly conducive to good work.

The stoneware pipes should be laid on concrete, at least 6 inches thick, and of a width equal to at least three times their external diameter, but the width and depth will probably be given in the specification.

The notes previously given on excavation, timbering, and concrete equally apply to this work. The Clerk of Works must decide if tunnelling may be allowed; generally it is advisable not to allow it if a trench can be cut, as it is more difficult to supervise work in a tunnel, and also more difficult to execute it properly.

For stoneware drains under the buildings the concrete should surround the pipes for a thickness of at least 6 inches.

If any of the trenches are under concrete paths, footways, or in roadways, these should not be made good or laid immediately, as the returned earth is sure to settle, no matter how well it is rammed.

If any timber is left in the trenches, on account of any risk or danger on withdrawing it, the Clerk of Works and the foreman must measure same up together.

For iron drains it is not necessary to lay them on concrete for their entire length, but small brick or concrete piers must be put behind the collars or sockets, and one in the centre of the length. These pipes do not require to be encased in concrete if under buildings, for which reason it is as cheap to lay iron pipes as to lay stoneware ones encased in concrete, providing the lengths are straight, without fittings such as gulleys, bends, etc.

It is the jointing of the pipes that requires the Clerk of Works' closest attention. No earth or concrete should be allowed to be placed over any pipes until they have been inspected at every joint. The Clerk of Works must remember that, once they are covered up, defects can only be remedied at great expense. He must see that no cement or other jointing material is left inside the pipe, where it would in time to come cause a blockage of the drain; he should insist, therefore, on the use of a proper badger to effectually cleanse out each pipe when laid.

It must be seen that the inside of the socket and the outside of the spigot end of the pipe are not so highly glazed as to prevent the cement adhering properly—if of too glazed a surface it can be chipped carefully.

Knowing that drain-pipe joints fail either from (a) the cement of the joint expanding, (b) or contracting, (c) by expansion of the concrete bed, either as a whole, from a "hot" cement, or in part in consequence of extra thickness in parts from uneven or too deep excavation, (d) by the sinking of the bed of concrete either as a whole or in parts as a consequence of a varying soil, (e) by testing before the joints are set, (f) by carelessness in surrounding the pipe with concrete, (g) by filling in before the joints are set, (h) by falling bricks or falls of earth consequent upon unsafe or insufficient timbering, (i) by the subsequent withdrawal of scaffold poles, or by the erecting of a scaffold at a later date over the drain—the Clerk of Works can take precautions to prevent failure from any one or all of these causes.

The jointing of the stoneware pipes should be made with cement. Gaskin rots in time and leaves a space, which, however small, is objectionable, so that a solid cement joint is preferable, but the joint inside must be left clean.

The joints of iron pipes are best made with lead rope caulked, and followed with blue lead, also well caulked.

Manholes.

The manhole and chambers should be built in cement mortar, and should be of a size to permit of a workman entering and using a rod effectively. The least dimension of the manhole should be 4½ bricks × 3½ bricks, *i.e.* 3 ft. 4½ in. × 2 ft. 7½ in., and manholes should be built in English bond, and where these sizes are increased, they should still be kept to exact brick dimensions, and not built as 4 ft. 0 in. × 2 ft. 6 in., or 4 ft. 6 in. × 2 ft. 9 in., etc., as brick dimensions facilitate good bonding. The manholes should be cement rendered, finished in neat cement to the top to ensure their being watertight, as a manhole affords an easy and sure means of testing the system.

For any chamber more than 2 ft. 6 in. deep, galvanized wrought iron ladders or foot irons should be provided, but in very deep ones the former are preferable. If neither are shown or mentioned, the Clerk of Works should obtain the architect's permission to have them put in and obtain the written order for the builders to do so.

The Clerk of Works as well as the architect should bear in mind that the drains will probably require periodical cleaning out, so that provision should be made that every branch (if possible) can be rodded, so that it is well to provide manholes or chambers at every change of direction or of gradient, and the Clerk of Works is advised to obtain permission to put in turning chambers where so required, if not shown on the drawings.

Testing of drains.

The testing of the drains must be thorough. The Clerk of Works will probably have to prepare, on completion of the drainage work, a plan showing how and where they were laid, giving falls and depths below a datum, and to sign same certifying at this time that they have been tested in his presence and found to be satisfactory. The testing must consequently be thorough for the conscientious Clerk of Works to be able to sign such a statement.

Every branch should be tested separately, as, though it is possible in some few cases to test a whole system at one operation, it is not advisable to do so, as the Clerk of Works cannot have each length under his eye at the same time, and the unscrupulous builder may only partially fill some of the drains, and these will therefore not be under test at all. No appreciable drop in the water-level at the higher end should show at the end of, say, half-an-hour.

For new drains none but the water test should be imposed, but the smoke test should be used for soil and ventilating pipes, pumped under pressure by an approved machine.

It is presumed that every aspirant for the post of Clerk of Works knows how to make a water or smoke test, so that explanation is not given here.

The supervision of the plumbing part of sanitary work will be given under the general work of that trade.

CHAPTER VII

THE SUPERVISION OF REINFORCED CONCRETE CONSTRUCTION

THE notes given on concrete previously apply in the main to that used in reinforced concrete construction, but there are several points upon which additional notes are necessary.

Materials.

First as regards the materials. The specification will probably ask that the cement has to comply with that of the British Engineering Standard Committee, and should be of a slow-setting quality in order to avoid the concrete commencing to set before the workmen have time to place it in position and sufficiently tamp it.

As the cement is such an important factor in the construction, tests of each consignment should be made, and the Clerk of Works should be furnished by the contractor with a written signed statement, at the time of each delivery, stating maker's name, date when taken from the kiln, and quantity delivered, and the Clerk of Works should himself take a sample from each delivery, and if he is not going to make the test himself should carefully label it, giving all the information given him by the builder, as well as the purpose for which it is to be used, and mentioning all specification clauses which govern its make and quality, to the person who is to make the actual test.

Under these circumstances no cement must be used that has not been previously tested and approved, and the store shed or room should be open at all times to the Clerk of Works.

The Clerk of Works should also test each consignment by means of the paste of neat cement or the non-porous glass or tile as previously mentioned, taking care not to use too much water. By pressing on the pat with the thumbnail, the time taken to set can be noted and a quick-setting cement avoided.

He can also take a similarly made pat and let it set under a damp sack. This will keep it out of the way of draughts and the sun, and the pat should be put in some place where it is not likely to be shaken by passing traffic or vibration of any kind. When set, the pat should be placed in cold water in a saucepan, which should be kept at a point just below boiling for a period of about three hours. For the cement to be fit for use at once, no cracks should appear.

The specification will most probably give the kind of sand and broken stone or gravel. If, however, these points are not as clearly defined as they might be, the Clerk of Works should see that the sand is clean and sharp and of a coarse quality, for it is important that it should vary in its size of grain if a thorough voidless concrete is to be obtained.

As regards the hard stone or gravel, its size must be such that it will pass between the reinforcements, so that it should rarely, if ever, exceed $\frac{3}{4}$ of an inch in diameter, and in columns and thin slabs a limit of $\frac{1}{2}$in. may have to be insisted on.

Mixing.

The question of the quantity of water required for the mixing, if not specifically mentioned, requires notice. If the least possible is to be used, there is the risk of some portion not getting sufficient to make it set properly. Concrete of this mixing, known as "dry," may be kept moist for seven to ten days, which can be effected by covering the completed work with wet cloths, sacks, etc., that will retain moisture in such a way that the concrete will absorb it.

If a sloppy mixture is used, ramming or tamping may not be possible, and it is likely that upon the water drying out, it will leave voids, which it is the object of good gauged concrete to avoid. The Clerk of Works will therefore be guided by the situation of the concrete; if it is to be in such a position that the concrete cannot be thoroughly well rammed, the "wet" concrete will give the best results, as its liquid state will help to consolidate it, but generally for concrete work the mixing should be made with just sufficient water for every particle of the aggregate to be coated with the mortar from the sand and cement. Also, a fairly dry concrete adheres better to the metal reinforcements than one of a wetter nature.

Shortly, without doubt, some tests will be carried out to enable architects to specify the consistency the concrete is to be after mixing. In hot or dry weather extra water must be added to allow for evaporation.

The actual mixing of concrete was described in a previous chapter, and need not be enlarged upon here, but the Clerk of Works should insist on it being mixed in small batches to ensure that none sets before it is deposited and rammed. Care must be taken in the ramming that the rods are not displaced or injured.

Tests.

If the specification demands tests of the concrete, the small cubes should be made in the Clerk of Works presence, either in metal or hardwood moulds, and must be well rammed, and immediately be labelled, as to date and position of the remaining concrete in the work, and when set, must be sent at once to the firm who will test them.

If the metal has to be tested, full particulars of the tests will be given in the specification, both as regards the requirements it has to fulfil and the length of the test pieces. These last the Clerk of Works will have to select, label, and send to the testing firm. As a rough test he may himself subject a piece of the mild steel to a bending test; it should bend cold through an angle of 180 degrees, with a diameter equal to its own thickness, without showing cracks on the outside.

Before use the Clerk of Works will see that the steel is freed from dirt, scale and grease, and given a good coat of cement wash if this last is specified.

If any rods are too long to be in one length, they must be hooked together, but the designer providing the working drawings of the reinforcements will probably note all such cases.

No welding under any circumstances should be permitted, unless the working drawings *distinctly* show it as allowable.

The drawings of the reinforcement must be clearly followed by the Clerk of Works, in order to be able to see that every rod and stirrup shown is put in correctly, both as regards position and number, and that all joints are made as described, and where depicted. The symbols of reinforcement joints will, no doubt, in time to come be standardised, when Clerks of Works will have an easier means of ensuring that the correct design of joint required is put in.

Forms, etc.

Before the materials above-mentioned are brought into use, the Clerk of Works will have been busy with the supervision of the framing, moulds, centering, shuttering (best known as "forms" in reinforced concrete work).

The work is mostly done by carpenters, but no doubt ere long with the extended use of this class of construction, a special trade will be formed—something between a carpenter and a carpenter's labourer—a sort of skilled labourer. This will at first lead probably to the employment of unreliable workmen, so that the supervision will require even greater care than at present, if such be possible.

It is the foreman's place to erect these forms, but as their cost is considerable, it is up to the Clerk of Works to suggest any improvements whereby saving or re-use of materials can be obtained, provided that by so doing the efficiency of the shuttering, etc., is not affected.

The specialist firm (if any) responsible for the design of the reinforced work may provide the details of the centering, and this will give the best results no doubt.

In its use the endeavour must be made to re-use it again and again, but the Clerk of Works must see that sufficient is supplied to prevent delay, and that none is struck before the concrete is hardened.

He will also see that whatever form it takes, that it can be easily dismantled without damage to the concrete, for which reason it may be necessary to only partially drive in the nails, so that they can be easily withdrawn. In fact, in many positions the nailing can be very sparse, as the concrete when put in will keep it in the position required. When bolts are used, they should be well greased before being put in, so as to allow for their easy withdrawal, and the holes so made must be filled up with mortar as soon as the bolt is taken out.

The designer, knowing that the construction of the timber work is a costly item in reinforced work, will have, as far as possible, employed beams and columns of a standard width, and the widths in which timber is obtainable may have been borne in mind also. Certainly the Clerk of Works should think of these two points in connection with the erection of the forms, etc.

The finish required will require notice, as, if the walls and beams are to be unplastered, better results will be obtained from planed boards than from rough boarding, and smoothness of finish can be obtained by the use of thick oiled paper, canvas, etc.; also paper is sometimes used to allow the concrete to readily separate from the centering, though this can be effected by painting the boards with a coat of soft soap or linseed oil, and often it is considered sufficient to play with a hose on the centering before depositing the concrete for the same purpose, but the specification will probably mention what the architect desires.

It is very important that all holes in the forms are stopped to prevent the cement laden water or mortar from running out, which would result in a weaker concrete.

The Clerk of Works should inspect each piece constructed before the concrete is put in. The joints of the boards are generally butted, *i.e.* square edged—to have them grooved and tongued being too expensive unless specifically mentioned. If necessary joints in the boarding can be stopped with clay, tow, etc.

The boarding must be well strutted and braced, as it has not only to support the weight of the concrete, but also of ramming, and materials afterwards placed on the floors, etc. The thicknesses of the boards generally employed are 1 in. for floor slabs, 1½ in. for beam sides and ordinary walls, and 2 in. for the bottoms of girders, and for columns or pillars. The distance apart of the strutting should not exceed 2 ft. for 1 in. boarding, 4 ft. for 1½ in. boarding, and 5 ft. for 2 in. boarding.

The timber need not necessarily be of "good" quality, but it should be free from large knots or their holes, nails or notched out pieces. It should not be too dry, as if so, it will swell from the dampness of the concrete. At the same time the boarding should not be too wide, as it is liable to warp if above 6 in. wide. The centering will probably be of fir, but if to be left unplastered the best results will be obtained by the use of white pine, as it will not warp or twist in the same manner as deal will.

The Clerk of Works will notice particularly that all shavings, chips, nails, sawdust, dirt, etc., are removed from the forms prior to concreting, and will see that the reinforcement *is* put in, that it is both sufficient in number and correct as regards position, and also that the concrete does not displace it. In the case of walls the concrete should be brought up from one level to another, and not filled in between the boarding to irregular heights. For the walls the shuttering to one side can be completed to the ceiling level, but the other side should be brought up as the concrete is put in and tamped. Similarly with columns, these should also be filled in foot by foot, and tamped until the mortar rises to the top.

If for any reason the forms get mis-shapen during the work, it is very rarely possible to get them back to shape again, and in any case the attempt to do so will in all probability crack the wall, when it will be useless, so that it is best to have the work pulled down as soon as noticed and re-erected.

The length of time the forms should remain in position after the concrete is in, depends upon the position of the work, the weather, and the loads to which the members are subjected, but generally speaking it should be kept up from 14 to 21 days, but with warm weather often seven will suffice.

In the striking of the forms the Clerk of Works should personally examine the work after the removal of the posts from one girder *i.e.* the whole of the forms of the girders in one floor must not be removed at once, and as soon as the forms from the beams, etc., are taken down the posts should be replaced at once.

The Clerk of Works will see that the forms for the columns can be removed without the supports of the beams being disturbed, so that in the event of any defective work in the columns, there is an opportunity of repairing or remedying the same before the load is brought to bear upon the column.

The Clerk of Works should have a general knowledge of the system of reinforcement followed on the particular work he is engaged on, and should study the bye-laws of the London County Council (when issued : they are now before the Local Government Board for approval). He should at least know why the bars are placed where they are, and again, through a mistake on the designer's part possibly, some point of weakness may exist, which was not noticed in the preparation of the plans, but which can be perceived whilst the work is in course of actual construction, and the Clerk of Works who knows what constitutes such points, is a boon to his employer, but he must remember that it is *entirely foreign to his duties to alter or try to improve upon the construction shown on the plans in this, as in every other class of work*, but he must see that what is shown is put in.

R.I.B.A. and C.W.'s duties.

Roughly, the Clerk of Works' principal duties are summed up in the report of the R.I.B.A. Committee, viz.: that very careful superintendence is required during the execution of the work in regard to

(a) The quality, testing, and mixing of the materials.

(b) The sizes and position of the reinforcements.

(c) The construction and removal of the centering.

(d) The laying of the material in place, and the thorough punning of the concrete to ensure solidity and freedom from voids.

CHAPTER VIII

THE SUPERVISION OF TERRA-COTTA

Owing to the ease with which terra-cotta is moulded, and its consequent cheapness, as compared with stone, it is largely used both in London and the Provinces, so that some few notes on the supervision of this class of work may well be included.

The terra-cotta part of a job frequently forms a separate contract, or it may be that, if included in the general bills of quantities, the architect has obtained a tender for the supply only, and that the amount of the same is mentioned in the bill, and the contractor has only to allow for filling the blocks, hoisting, and fixing. In this case the builder has no need to submit samples, the architect having approved the ware before the inclusion of the price in the quantities.

Delay in delivery.

Perhaps with no material is there more likelihood of delay than with terra-cotta, and it is wise when the contract stipulates that so many cubic feet shall be delivered in a given period. If no such clause exists, the Clerk of Works should endeavour to obtain such a promise, and when obtained see that is kept.

Many of the notes given in the article on "The Supervision of Masonry," apply to terra-cotta. The Clerk of Works will oftentimes be sorely puzzled to know whether to reject a block or not, on account of the great delay in replacement, as it means re-moulding and reburning in all probability ; but often a manufacturer will make duplicates at the first time of burning specially to avoid such delays, and it may even be a condition of contract on a specification clause that this be done.

Being a manufactured article there are many defects for which terra-cotta can be refused, as it warps, twists, shrinks, etc., and consequently arrises are not always true, but in the approval of the material, the Clerk of Works must consider all causes and effects, and use his own judgment in the matter.

The architect will furnish full size details. These the Clerk of Works will check as soon as received. He will note that provision is made for the brickwork backing to bond in with the blocks of terra-cotta.

Storing, fitting and fixing.

As in masonry, the terra-cotta manufacturers will supply fixing plans, and the Clerk of Works can record the delivery of each particular block as previously mentioned, and the remarks re storage and protection of both unfixed and fixed blocks in the former chapter on stonework supervision equally apply here. It is, however, necessary to see that the blocks are raised above the storage place ground level, as when standing in water or laid on or surrounded with wet straw, the blocks are apt to become discoloured. It is the underburnt blocks which discolour, taking up a greenish tinge. Terra-cotta blocks should not absorb more than 10 per cent. of their weight of water.

The colouring should be the natural result of burning, and not the result of a coat of wash before kilning. The colour will vary with the amount of burning, and with the percentage of iron present, and also on the clay itself. The actual tint the architect approves of should be known to the Clerk of Works, also the surface finish, as some prefer a combed surface (effected before burning), whilst others require the smooth finish.

The points the Clerk of Works will look to in the approving of blocks delivered, will be that they are free from cracks or lumps on the surface, from twist or warpage, and that the colour is of one uniform tint. Moulded blocks must be true in shape, *i.e.* not distorted, and the lines of the same must be approximately accurate. In no case may the faces be chipped, or rubbed, etc., as when the outside vitrified skin is removed the exposed ware will not weather, the under body being of a porous nature.

Each block should fit in its place, without having to resort to cutting, but it would be indeed an exceptional job on which a little indulgence had not to be given both as regards cutting the blocks (beds and joints) and the trueness of the lines—but in no case should the chipping of the front of the block be allowed.

The whole of the clay used in the manufacture should be of one quality, as to cover an inferior ware with a superior clay will only result, owing to its unequal shrinkage, in the reducing of the strength of the block, and in the appearance of minute cracks on the surface, which will allow of moisture to enter, which may freeze in the winter months, expand and burst off the outer layer of clay, and may also allow of dirt to get in and so give an unsightly appearance.

The best men to set terra-cotta are masons, unless skilled terra-cotta setters are available. The joints are also similar to masonry ones, but the end of each stone generally has a rim or raised margin about one inch wide round the whole of its edge, and the sinking within this rim is from $\frac{1}{8}$in. to $\frac{1}{4}$in. deep. If this joint is well flushed up, the blocks should not be able to move laterally, this sinking taking the place of the double V and pebble joint in stonework.

The joints should be from $\frac{1}{8}$in. to $\frac{1}{4}$in. according as the specification asks, and should be made with cement mortar; the Portland cement pointing should be weathered, and the Clerk of Works should note if it is to be coloured or not.

Before the blocks are ready for hoisting they have to be filled with concrete, which is generally of broken brick, sand and cement, which may be either Roman or Portland; but, if the latter, it is important that it should be quite fit for use, to avoid its expansion bursting the blocks. Terra-cotta blocks used in floors need not be filled unless specially so specified.

The Clerk of Works should personally supervise this filling up, and should see that the blocks are well soaked before the concrete is put in. He must watch that no cement is allowed to run over or is splashed on to the face of the block, as in removing it afterwards, the vitrified skin may be chipped off also. Spirits of salts may burn off the splashes.

Protection.

The mortice and lewis holes should be put in the blocks before burning. Cornices, hoods, canopies, etc., should be covered with lead to prevent water finding its way into the edges of the leaded in cramps, etc., or the filled up lewis holes, where these have to be placed beyond the wall line of the block. If this lead covering is not specified, the Clerk of Works should suggest its employment to the architect.

The Clerk of Works should see that provision is made for the upholding of large canopies by threading small joists, etc., through the blocks or by other means which suggest themselves, and that cornices are efficiently held down.

Fäience work.

On many buildings glazed terra-cotta is employed, technically known as fäience. All the above notes hold good, but the Clerk of Works should see that the quality and colour is maintained.

In this material also the architect will have determined the exact tint, and have approved samples. It is very important that the glaze should be well fused into the clay, and that both glaze and clay expand and contract at even temperatures, otherwise the former will split, craze, etc., when the blocks will not weather as well, and the cracks will fill with dirt, etc. If, however, the selection of the sample is left to the Clerk of Works, he should insist on leadless glazing, as equal results can be obtained from slip glazing without the danger there is to the dippers in the former method.

CHAPTER IX

THE SUPERVISION OF CARPENTRY

THE supervision of carpentry cannot be too careful, as in many instances it is hidden from view by the finishings. Owing to the decline of apprenticeships, the type of carpenter now found on most buildings is one much less practical and less trained than a few years ago. Many carpenters on jobs to-day have neither a full kit of tools, nor would they have the ability to use them if they were possessed of them. The result is that good timber is often spoilt by inferior workmanship. The Clerk of Works is there to see that both the quality of materials and the labour employed is of the best description.

Approval of timber.

The supply of timber is declining, and the price of good timber is consequently increasing, and it is but to be expected that contractors buy the very cheapest quality that there is a reasonable likelihood of the Clerk of Works approving. If the Clerk of Works is not a carpenter or joiner by trade, or has not had considerable experience in the selecting and approval of timber, he is liable to be over-persuaded by the builder into approving a timber that is far below the standard that he might reasonably insist on as complying with the specifications.

Notes on the materials had better be given first, as it is more important to have good quality timber than to have good quality workmanship, as it is a distinct waste of money to put good labour into inferior material.

The Clerk of Works will certainly know the principal defects in timber, and the shape or form they take so as to recognise them. He can look upon heart, star, cup thunder shakes as defects, similarly also upon twisted fibres, loose, dead, or large knots, waney edges, wind cracks, sap and unseasoned wood. He must, however, use his own judgment as to whether one or more of these defects is sufficient cause to warrant the rejection of the timber containing them, according to the purpose or proposed use of the particular piece of timber.

It is very important that dead wood should not be used, *i.e.* timber from trees that have died from disease or old age. Such timber can generally be distinguished by its lightness in weight, compared to healthy good timber, and also by its reddish chrome colour.

The Clerk of Works should not go hard and fast by the marks on the ends of deals, etc., though they form a fairly reliable guide as to the quality; also the manner in which the marks are made act as a guide to the country of export—for example—timber ex-Russian ports is branded by a hammer with devices on the ends. In Prussian timber roughly gouged-out letters are placed on the sides, near the middle. Norwegian timber has the shipper's initials stencilled in blue paint on the ends; whilst that of Swedish ports is similarly stencilled in red, but its inferior qualities are stencilled in blue.

The Clerk of Works will see what the specification demands as regards quality, and it is very rarely that the architect will specify brands, but rather the quality and country of export; or he may leave it at the word "best," in which case the builder has a larger quantity and area to select and buy from, but the Clerk of Works must interpret the clause as the best obtainable and most suitable for the particular use for which it is proposed to use the timber.

The points the Clerk of Works will pay particular attention to are that in bearing timbers there are no large knots, and that no cracks or splits are apparent. As regards sappy or unseasoned timber, the main characteristics are that it is liable to warp and shake with changes of temperament, and that it is more liable to rot than well-seasoned wood. It is generally discernible by feeling rough and damp when sawn, and by it being more difficult to plane than good well-seasoned timber.

The specification may demand that the timber is to be English cut, and when this is so, the architect will generally specify sizes that prevent the supply of imported sized timber. His sizes, for instance, may be $4 \times 2\frac{1}{4}$ or $4\frac{1}{4} \times 2$, so as to exclude the 4×2 foreign cut article.

Some points for the Clerk of Works to watch in hard woods will be given in the article on joinery supervision.

Assuming that the timber supplied is approved of by the Clerk of Works, he must then see that it is stored in a properly protected manner, out of the action of rains and winds. The fact that it was approved as a whole at the time of first inspection after delivery will not prevent him from rejecting any deal or piece of quartering subsequently, as after fixing in position, or whilst still unfixed, defects may show up which were hidden or undeveloped previously; particularly is this so as regards wind cracks, etc.

Workmanship.

The timber in floors, roofs, etc., will be described in the bills of quantities as "fir framed." The word "framed" will include all the labour of the usual preparation for and fixing of the timber, but cogging and notching should not be included as coming with the labours of framing. If these labours are desired they should be specifically mentioned in the preamble to the carpenter's bill, specification, etc., and it must not be forgotten that notching reduces the strength of the beam by the depth of the notch.

The fitting of a rafter on a wall plate is often merely a "touch here and there" between the two members, but the Clerk of Works should see the first few cut and fixed, and note their fit. If they are not all they should be, he should at once call the foreman's attention to the bad cutting, and insist on a perfect fit of each member one to the other in all cases.

This—the simplest of all carpentry labours—is often executed very disgracefully, in fact, on some jobs I have often wondered if the workman wielding saw and hammer was really a carpenter or a labourer, whose carpentering experience was that obtained by the roughest of strutting, planking of trenches, pier holes, etc. And when one sees as well a cut nail inserted with its head across the grain, then it is time to ask the foreman to discharge such a carpenter as absolutely incompetent—this is not a fiction, but a fact. Of course, the foreman should himself notice such impostors as these, but he has less time for watching than the Clerk of Works.

Another item of labour requiring close supervision is the accuracy of the workmanship in scarfing joints—that the proper joint is put in according to the strain to which the member is subjected. Hard wood wedges should be used.

The Clerk of Works should go well into the construction of every part of the carpenter's work before the workmen are called upon to execute it, so as to know the exact method of framing shown or desired, also levels, heights, etc.

If any large-sized timbers are required he will see that they are brought on to the job quite early, in order to avoid delay in procuring them, and also if taken from the pond that they may have a chance of drying, and that all shrinkage may take place before fixing. In any case early framing of roofs and partitions should be insisted on.

Coming to the actual items requiring supervision, the Clerk of Works will see that there is ample ventilation under ground-floor joists. To provide some, but not sufficient ventilation is only to assist dry rot fungi to exist. Before the joists are put in, the Clerk of Works must see that the concrete over the site has been put down and that it is solid, *i.e.* not cracked or displaced.

Floors and roofs, etc.

If the specification does not state the distance between floor joists and between rafters, they must be put not more than 12 in. apart; whilst ceiling joists should be spaced at 12 in. centre to centre to save waste and cutting in the lathing.

The Clerk of Works will see that trimmers are put in where required; these are usually 1 inch thicker than the common joists or rafters.

It is important to see that the ends of the beams, joists, etc., are not built in, but that there is a space round the entire ends.

Herringbone strutting should always be double and spaced at about 4 ft. between rows—but this point the specification will most probably determine.

If beams are flitched see that the heart sides are turned outwards, and that the flitch is kept $\frac{1}{4}$ in. short of top and bottom to allow for shrinkage. Also that most of the bolts are placed above the neutral axis or centre line of the beam, and that those that have to be placed below this line are near the ends of the beam.

In roofs see that the proper height or slope is obtained, that openings for skylights, chimneys, etc., are trimmed with proper thickness trimmers, and that gutters are formed at the top of these where necessary. In the trusses see that timber of the correct sizes is put in, and that the shoulders of the stub tenons, etc., are cut square, that all members are accurately fitted, that the iron straps, stirrups, etc., are properly forged and effective in use, and that in the tightening up of the gibs and cotters the strap is not split through.

The slate or tile battening must be looked to, to see that it is laid to the correct spacing, and it will of course be laid upon the felt (if any) so as to get an air space between the felt and slates.

If boarding for roofs is described as with "edges shot," the Clerk of Works will see that this is done; it ensures a tight joint between board and board. The boards should be nailed on with nails that enter the rafters about $1\frac{1}{4}$ inches.

The Clerk of Works will see that no timber is put into or runs through any flue.

It is desirable to make partitions self-carrying if possible, with their ends supported on templates as in roof trusses. Where they run parallel to the floor joists, the weight of the partition should be borne by two joists, which should be bridged together to support the partition. The Clerk of Works will examine each partition and see that it is properly framed up and has been fixed perpendicularly.

Timber on flats to be covered with lead must be traversed just prior to laying the lead, to avoid the ridges of the boards cutting through the covering. The Clerk of Works must make a point of seeing that firring to flats and dormer tops are neatly and firmly fixed, that the gutters are constructed to proper falls, that the drips are properly formed, and that the deal rolls are securely fixed.

All parts to be covered with lead, etc., must be well brushed before the lead is put on, to remove all shavings, chips, nails, etc., that would cut through if afterwards trodden upon.

Centering, protection, etc.

In the temporary flat centering to concrete floors, partitions, lintels, etc., it must be noticed that the proper depth and thickness for the floor, etc., is allowed, and that the centering is sufficiently strutted and supported, or properly horsed up from the joists above.

The centres for arches should be inspected by the Clerk of Works, to see that they are true in shape and of correct span and rise. If they are for rubbed and gauged or purpose made arches, it is advisable to have the lats or laggins planed over, to ensure they are all of equal thickness, so as to give an exact intrados to the arch. At the same time see that the centres are supported on hardwood wedges, well greased, to allow of their gradual loosening, so that the arch can take its load gradually.

The centres for large spans should have supports at the centre where possible. The laggins in all cases must be spaced equally apart to give best results, a brick or stone should not rest upon one lag only. The Clerk of Works must see that no centering either for floors or arches is struck before the floor, etc., has set.

In the protection of projections of stone, brickwork, or terra-cotta, it is an effective method to have zinc strips nailed to the protection boards, with the loose ends of the zinc, built into the brick or stone courses, from which at cleaning down time they can be easily withdrawn.

Notice must be taken that the wood blocks, bricks, or slips as specified, are built in as the work proceeds, where required for fixing joinery work to, and that sufficient number are inserted. It must be seen that no plug, slip, or woodbrick is inserted into any flue.

The Clerk of Works will see that any parts of roofs, etc., that have to be wrought and painted, are wrought before fixing.

Restoration work.

If the contract includes repairs to old roofs, floors, etc., of historical interest, the Clerk of Works should see that the least amount possible (if any) of old timber is removed, and where possible the work should be carried out in the summer months. Before any roofing is removed, he must see that ample protection from the weather is given by tarpaulins, etc., so as to keep the roof timbers perfectly dry.

CHAPTER X

THE SUPERVISION OF JOINERY

JOINERY, as a rule, is better supervised than carpentry by Clerks of Works, probably owing to the fact that it is always open to view; but joinery can be, and often is, scamped by builders.

The main points to look to are the quality of the timber used and that the fixing is properly executed, and that nothing is allowed to injure the work after it is once fixed. The careful foreman will pick his men for this work; he cannot expect all carpenters to be joiners, and joinery should be handled only by the latter class.

Inspection of materials.

As regards the materials, the specification will no doubt give information as to quality and country or place of export. The Clerk of Works must see that he gets good well-seasoned timber, free from shakes, large knots, and streaks of resin. For work which has afterwards to be stained and varnished the timber should be as free from resin as possible, as the resin prevents the stain penetrating below the surface of the work, and when the varnish is applied the stain is taken off; also timber for such work should be free from knots, and be well seasoned before used for joinery. It should be ex-Memel, Dantzic, or other North Prussian ports.

For open or hammer beam roofs, if of deal, and for other work where strength and durability is required, timber from Riga and St. Petersburg is generally specified, as, coming from higher latitudes, the wood is denser.

and consequently stronger than wood grown in lower latitudes.

If the builder's yard is near the job, the Clerk of Works will make several visits in order to see the timber before any priming is put on, and if the joinery is being made at some distance away, the builder will naturally endeavour to deliver as large consignments as possible at one time, and so the Clerk of Works, instead of making several journeys to inspect a few articles, can make only one or two, and inspect the whole consignment before delivery.

In any case the joinery should be inspected before the work is primed, and if the works are too far away for the Clerk of Works to journey to, then the architect will make other arrangements for its inspection. Joinery with dark priming should be looked upon with suspicion—it may be dark to cover defects.

If English oak is specified, the Clerk of Works will see that it is free from knots, wormholes, and cracks.

Work in oak.

Knots in purlins and other bearing timbers are a great source of weakness. Knotty timber twists and crooks as it seasons, and unless well-selected oak is chosen for sills, frames, and mullions, the sash of a straight-grained wood, as mahogany and teak, will be forced out of the rebates of the frame; thus often yellow deal is preferable to knotty oak.

The Clerk of Works cannot, of course, see the log from which the oak is cut (except in the case of estate Clerks of Works, when the oak timber may be cut from the estate), but it should be cut from the trunk of a straight-grained tree below the lowest branch, that has been felled at the correct time—the winter—and ample time must be allowed for seasoning.

As oak shrinks when its outer skin is removed, even after years of seasoning, the Clerk of Works should see that the oak is worked to its correct section quite early after the signing of the contract.

As Odessa wainscot is more liable to split than Austrian, the latter should be insisted on for best work.

It is obtained from larger trees than the former, and consequently larger sizes and more figured material can be obtained. It is also of a more uniform colour.

Mahogany must be dry before it is put in use for joinery, and dead knots, cracks, or shakes must be objected to.

Flooring.

As regards the flooring, the specification will mention the timber to be used, and the class of floorboard, giving width and section of board and how laid. The idea of using narrow widths is to reduce the likelihood of shrinkage, but the Clerk of Works must see that seasoned timber has been used, as often narrow boards are cut out of small and unseasoned timber. He must see that the boards are not laid "folding," as this means four to six boards all of one length, all ending on one joist.

This is objectionable, and furthermore the edges of boards laid that way frequently get damaged by the sometimes failure of the boards to "fold." The boards should be laid separately, each being compressed into its place by "flooring dogs," levers, or cramps, and each board should be of a different length to the other.

If special section flooring is specified, as rebated and filleted, ploughed and tongued or dowelled, the Clerk of Works must see that the proper section is used, and that the fillets and tongue fill the rebate and plough groove respectively. In the dowelled floor, failing definite directions in the specification, the dowels should not be more than eighteen inches apart, and no nails should be visible. If oak dowels are specified, the Clerk of Works must see that no substitutes are put in, and that those put in are of the proper size.

Another point for the Clerk of Works to watch is that no board with waney edges is allowed to be laid, nor yet ones with knots knocked out or with sappy edges, and that the planing of the boards is good—if the machine has dull planing irons the marks of these can be distinctly seen, and if the floor is not to be covered with linoleum or carpets, he should insist on the removal of these marks at the time of the cleaning off of the floor.

The Clerk of Works should particularly notice that hand-prepared boards are not specified—if they are he must see that they are so prepared and put in.

The best boards show the annual rings at right-angles to the floor face, and though this is not obtainable with every board in a consignment, they should not vary more than thirty degrees from a right-angle, to avoid the shedding of the board becoming dangerous to thin soled boots, also thus cut flooring withstands wear and tear better.

The Clerk of Works will request the builder to purchase the flooring as soon as the contract is signed, so as to give it every chance of being fit for use when required. The specification will probably mention that any joints that open are to have the boards renewed.

When once a floor is laid it should be covered up with sawdust as a protection, and no men should be allowed either to basket materials through such a room or to have meals there.

If the flooring is nailed to joists dovetail section, in concrete, the Clerk of Works must be particular to see that the concrete has quite dried before the floor-boards are nailed down, as to seal up the moist air beneath such a floor is to set up dry rot, and this will be further induced if linoleum is put down upon such a floor.

If the wood skirting is specified to be tongued into a groove into the flooring, it is very necessary that the latter is quite seasoned. The Clerk of Works must see that intentionally or otherwise the tongue is not chiselled or split off.

As the laying of boards in a room is being finished, it is occasionally noticed that owing to unequal compression by the floor clamps, the end boards are not parallel to the wall. This the Clerk of Works will watch for, and, if found, insist on its being remedied.

Unpainted work.

One point the Clerk of Works must be careful to watch in his visits for inspection of joinery, is that of the matching of timber in work that is to be left unpainted, or is to be polished or varnished. The inspection of such work must take place before the framing is wedged up. The panels must be as near as possible of an equal amount of figure, and the styles and rails must be of an even colour —this will not result if any sapwood is present, as this is of a different colour to seasoned wood. The styles and rails should also be of straight grain.

If panels are of two pieces with a glued joint, the perfect matching of the two pieces is essential, as to put sapwood next to hard wood or plain against a figured piece is to show up the joint at once.

If the figured panels are veneer, the veneer should be on both sides of the panels, or otherwise that on the one side will pull the panel round on the face. Straight grained mahogany, although expensive, is one of the best woods to veneer on.

Panels.

For ordinary panels and mouldings yellow pine is an admirable wood, on account of its width and absence of knots. It is also an easily worked wood, is light, stiff, and durable, and on a first-class work the Clerk of Works should endeavour to get the builders to put it in, to avoid joints in panels, even if not specified, and as the increased cost of the timber is about equal to the extra labour of forming the panel with a joint, no "extra" should be incurred.

Some specifications state that the panels of doors and framing where over ten inches wide are to be of white-wood, when the Clerk of Works will see that such panels are put in. Whitewood is sometimes confused with basswood, both of which are of American growth, but they are distinct in leaf, weight, and the manner of showing their sapwood, and the former grows to a diameter twice that of the latter. Whitewood is lighter in weight than basswood.

The sapwood of basswood is not distinguishable from soundwood, but with whitewood the sapwood is quite discernible, being nearly white, whilst the soundwood colour varies from light greenish yellow to a yellowish white.

Before required by the builder, the Clerk of Works will have obtained all necessary full-size joinery details from the architect, will check same with the positions they are to occupy, and of course see that the work supplied conforms to the details.

Fixing of joinery.

The supervision of the fixing of joinery framing, etc., will occupy some little portion of the Clerk of Works' time. He will previously have seen that wood bricks, slips, etc., have been built in. He will notice that fixings, grounds and dovetailed backings are fixed securely and are truly vertical at all points in their length and width. If framed grounds are used, he will see that they are of the correct width, thickness and design. These grounds allow the plastering to be finished to a true plane.

In the fixing he will insist on the foreman removing all men who do not seem fitted to fix it properly, or failing to effect this (and there should be no reason why his request should meet with failure, as the architect will support him), he will ask the builders to renew all work improperly fixed or spoilt in the fixing.

If the Clerk of Works has been a good joiner himself, he will know at least one way of well fixing the particular work, though the way chosen by the joiner in question may not be his. He should not interfere until he is sure of bad results, when he must be firm in any action he takes. The grounds whether for skirtings, dadoes, windowbacks, or doorways, should be fixed as soon as the building is covered in. The plastering can then be proceeded with, after which the floors can be put down, when the joinery can be commenced to be fixed, starting at the top floor and working down.

In dado and other panelling, if of hard wood, the fixing should be secret, and this may be said to be so with all hard wood joinery. The back of the panelling should be planed over and given a coat of thick paint,

Framings.

and it may be that the specification asks for the whole of the dado and other backings to be rendered flush to prevent moisture getting to the back of the woodwork; if this is so, the Clerk of Works will see this is not omitted. He will also see that all mouldings are truly mitred, and are not fixed to the panels, leaving the latter free to shrink in the width at any rate. This applies to all panels.

In door and similar frames, notice must be taken that the correct section has been worked, that transomes are double tenoned, and that proper hammer keyed joints are made where circular work is concerned. It will be necessary to see that sills where specified to be of oak or teak, are really of that wood, that galvanized proper sized water bars are put in where necessary, and are properly bedded in white lead.

Doors.

In doors, see they are properly framed up, that lock-rails for mortice locks have double tenons, and that all tenons are as such in hardwood framings over two inches thick. See that, where diminished styles are specified, the work is so constructed that no doors or other framings wind, and that the former are properly hung with the proper kind of butt or swing hinges, and show an equal joint all round, and that the edges of doors are properly shot, and the arrises are not damaged. In order to avoid a difficulty in opening doors of rooms covered with thick carpets, the flooring at the doorway should be raised; generally one board wide and ¼ in. higher than the rest and shaped saddleback, answers the purpose. The Clerk of Works should obtain the information as to which floors are to be covered as early as possible.

Sashes.

For sashes see that the meeting rails "meet" and are level, and that bars are truly horizontal and vertical as required. With casements see that the frames and sashes are morticed and tenoned together, and oak pinned and not screwed, and that thick paint has been put on the frame joints before wedging and pinned up.

The Clerk of Works will note, if provision is made on the detail drawings for taking away the "condensed water" by inserting small copper tubes, weepholes, etc. These last after boring with a brace bit, should be charred out by means of a hot iron to remove all roughness from the hole, so as not to interrupt the flow of water.

In all casements opening inwards, provision should be made for rain not beating in. If nothing is shown, the architect's attention should be called to same, with any suggestions the Clerk of Works may have to offer.

In double hung sashes and frames, it must be seen that the former have been properly weighed and the correct weights put in. For plate-glass these will be of lead.

Joints.

There are several points to look to in the joints of joinery. If hard-wood tongues are specified they must be put in. If slot screw or dovetail keying is required, the Clerk of Works must see that these are properly constructed. In high-class dado and similar work, the external angles should be secret dovetailed mitred, and internal angles should be grooved and tongued.

The Clerk of Works will look to the scribing at internal angles of mouldings where required. In wood brackets for cornices, it must be seen that they are securely fixed. In any diminished, enlarged, or raking mouldings, or entasis work, the Clerk of Works must check the working out of these. If the ceilings are wood panelled, the timber used must be thoroughly well seasoned, and any containing the least suspicion of sap or unseasoned conditions must be rejected, as this part of a room is subject to varying temperatures, and every precaution must be taken to allow for shrinking and avoidance of the panels casting. If the panels are too large to be in one width, the joint must be grooved, tongued, and glued, and to prevent casting, dovetail keys should be fixed at the back across the panel at right-angles to the grain by means of slotted screws.

With wooden staircases, the Clerk of Works must see that they are properly wedged, blocked, and carriaged. When the foreman has made the story rod and pitch board, the Clerk of Works should check both. Veneered and blocked bullnose and curtail steps are preferable to kerfed ones, and the former should be insisted on.

Ironmongery.

The last item in the joinery bill is the ironmongery. Those items provided by the builders will have to be approved by the Clerk of Works. He must see in the fixing of these that proper screws are used—brass ones for brass goods and steel for iron items, and where required round-headed ones are put in. Also that they are of a sufficient length and fit the holes exactly, and that there is one for each hole.

All keys to doors should be labelled by the foreman as the lock is fitted with an untearable label, written on in indelible ink or pencil. They should be kept by him until the completion of the job, as after rooms are finished, it may be necessary for someone each day to go round and open and shut windows and see to fires for drying-out purposes. The Clerk of Works should personally keep the master key, and should see for himself that it passes all the locks.

Floor springs should be properly fixed and adjusted, and if the springs are of a checking nature it will be necessary to see that a check is obtained and acts properly. The Clerk of Works should see that oil is left in the springs as required at completion.

CHAPTER XI

SUPERVISION OF SMITH AND FOUNDER'S WORK

Delay in steelwork.

NEXT to terra-cotta, the steelwork for a building is most likely to cause delay, and it is imperative on the part of a Clerk of Works that he goes carefully through the steel work required, floor by floor, with the foreman or the builder's steel constructional engineer, early enough to settle all points open to question, so that the order to the firm supplying can be given in ample time for delivery to be made before the goods are actually required for use.

Any points on which the contract drawings are not clear must be referred to the architect for a further detail drawing or explanation, as every rivet and bolt plays an important part in the construction of a joint, and no matter how qualified the Clerk of Works may be to determine the sectional area of metal or number of rivets or bolts required in any particular piece of construction, he should not take upon himself the responsibility of such constructional details.

Approval and testing of materials.

The testing of the steel and iron is not usually such as can be carried out by a Clerk of Works, but has to be done by a firm of experimental engineers, if the steel works' tests sheets are not accepted by the architect in lieu of independent ones.

The Clerk of Works will have to mark the pieces of girders and plate required for testing by means of a steel die, and the selected pieces will have to be forwarded to the testing firm, mentioning the particular job the test is for, giving a facsimile of the die impression, and stating the architect to whom their report is to be sent.

The Clerk of Works should with the same die mark the remainder of the steel plates and girders from which test pieces have been taken, in order to ensure the same metal being actually put in the work. If the Clerk of Works inspects the work before it leaves the steel works, he will then be able to see his die stamps upon the sections; but if the steelwork is delivered on the job, covered with a coating of paint, the marks will be hidden most probably.

The coating with paint or cement grout will be mentioned later.

When the steel comes on the job, the Clerk of Works will (assuming he has not inspected it when made up at the yard) examine it first of all for correct sizes, both as regards dimensions of section (and weight) and length, as there is no need to search for other defects if these are incorrect Foreign rolled joists can usually be detected by the dimensions being in millimeters instead of in inches, or in the case of some of the small English steel joists in parts of an inch, as, for instance, 4 × 1$\frac{3}{4}$ × 5 lbs. The Clerk of Works should obtain a copy of the Engineering Standards Committee's list of standard sizes of joists, giving weight per foot run, sectional area, thickness of members, etc. It will aid him considerably in his inspection of steelwork, for in some cases foreign joists may be made specially to English sizes, and to obtain the weight the web may be thickened, without, of course, increasing the carrying capacity of the section.

English rolled joists usually have the maker's name in raised letters on the web, whilst foreign ones must have the country of export marked on them, but if only a short piece of girder is required, the part containing this information may have been cut off. The Clerk of Works should look at the ends of the sections, as some foreign joists are made up of portions welded together, and with a foreign joist the edges are generally more square than those of English firms.

Too much time cannot be given to the inspection of all girder and stanchion connections. The connections are the weakest part of steel construction, and the strength of a structure is that of its weakest part. The Clerk of Works should therefore check *each* connection with the detail drawings, both for thickness of plates and size, disposition, and pitch of rivets.

The length of a girder is a very important point for the Clerk of Works to check, as the other dimensions the foreman can take from the drawings, but the length has to be obtained from the building, and even the most careful foreman is liable to make mistakes. The writer remembers on one job, some years ago, a large compound girder, composed of two 18 in. × 7 in. × 75 lbs. joists, with plates, top and bottom, being delivered late on one afternoon, and it was not hoisted at leaving-off time that day. The girder was to carry a main wall, and to rest on steel stanchions, encased with brickwork, at either end. However, at about nine o'clock the following morning, when the Clerk of Works arrived, not only was the girder hoisted, but the cover stone was on and the ends built in.

True the builders had been waiting some time for the girder, and work had been hindered by its non-delivery, but the speed of this part of the work was so much in excess of what had previously been obtained, that this looked suspicious in itself. The work on the girder was stopped, and the ends uncased, only to find the girder end right off the stanchion proper, and resting but a few inches on the top plate of the latter. The Clerk of Works is therefore bound to be suspicious.

In the actual inspection of steelwork at the works, the points to watch are that all edges and ends of plates and ends of angles, tees, channels and rolled steel joists for stanchions and similar work are planed, and where this is not possible they should be finished off neatly with a chisel and file. This is necessary in the case of stanchion cap and base connections to obtain true bearing, but it is also necessary for the sake of appearance that the edges of plates in roof trusses or lattice girders exposed to view should be neatly finished.

Any straightening of plates, etc., should be done by passing the metal through plate rolls, and not by hammering. Bending of tees and angles to form, say, stiffeners to girders, should be effected by an hydraulic press.

The Clerk of Works in his inspection of the stiffeners will see that they have been made of the correct size, neither too long or too short; and this can readily be perceived by the uneven or wavy edge of the plates on the flange, these being brought down or forced up according as the stiffeners are too short or too long for their purpose.

The specification will probably state that the holes in girder and plate work are to be drilled. This will preclude the punching of holes, even when the punched hole is preliminary only to finishing by drilling; furthermore, the architect in his calculations may have only taken the nominal size of the rivet, allowing the holes to be drilled, whereas if punched holes were expected, at least $\frac{1}{16}$ of an inch increased diameter of hole, per rivet, would have been taken by him in his working papers.

All holes in plates should be concentric, and looking at the section of the plates joined, it can be readily seen if the templates have been properly used. The marking from a template on to a plate requiring straightening will often cause the holes in the plates not to be concentric at the time of riveting. In the case of plates and flanges, and the angles of built-up or lattice girders, the holes should be drilled through the entire thickness at one operation. It should be noticed that there are sufficient bolts put in to thoroughly well hold the plates, etc., together whilst the work is being riveted.

As regards the riveting itself, the Clerk of Works will see that the proper size rivets have been put in, and that they were of sufficient length for the thickness of the joint. A rivet too short in the shank will show a small head on the closing side, and must be rejected, cut out, and replaced. The cupping tool or snaps will also cut into the plate. One too long in the shank will show a collar ; this is objectionable where appearance is of importance, as in any work left uncased below the level of the eye, but there is no special need to have such rivets cut out unless the specification mentions collars as not to be permitted. The Clerk of Works will also see that the edge of the hammer has not cut into the surface of the steel by the careless or incorrect holding of this tool by the workman.

It is important to see that the rivets properly fill the holes. This the Clerk of Works can tell by striking a smart blow at the side of the head of the rivet with a small hammer, when it will be noticed that there is a distinct tone in the ring from a rivet properly forged from one improperly driven.

It is as well to adopt some system of marking rivets that have to be cut out, in order to be able to trace them again for inspection after riveting. The same die the Clerk of Works used for stamping the same pieces of metal can be used on the rivet heads, and the rivet surrounded by a circle of prominent colour paint, and the opportunity is taken here of remarking that under no circumstances whatever is either the foreman or any of the workmen to obliterate, or destroy, any mark (blue pencil, paint, or only symbol of rejected work or material) the Clerk of Works puts on an article. To do so must be looked upon as serious misbehaviour, deserving the dismissal of the workman concerned.

If machine riveting is specified the Clerk of Works will see that it is obtained when visiting the works. Machine riveting shows better formed heads, and the rivets fill the holes better also, owing to the continuous pressure. as against the jerks of the hand riveting method ; this can be proved when rivets have to be cut out, as often after knocking or cutting off the heads of a hand-driven rivet it is comparatively easy to punch out the shank, whilst with machine riveting it probably means drilling out the rejected rivet.

It will be necessary for the Clerk of Works to see that the rivets are put in to the correct pitch, which should never exceed six inches, as over that spacing moisture may find its way in between the plates.

Assembling at works.

Where the steelwork is of great importance, and of large quantity, the specification may demand that the whole of the work is to be temporarily put together or "assembled" in the steel contractor's yard, so that the architect or engineer can inspect each girder and connection in its relative position to that which it will occupy in the actual work. Where such a clause is in force this will be the time for the Clerk of Works also to visit the works and see for himself all the points previously mentioned, as regards plates, bending, planed ends and edges, etc., also that countersunk rivets are put in where required, and that a correct camber is obtained.

Other points to note are that the plates, etc., are free from scale, rust and laminations, and that proper distance pieces or separators are put to parallel girders. Proper separators do not necessarily mean pieces of gas barrels, as other and better forms are obtainable. The Clerk of Works must also see that proper bevelled packing pieces are put in where necessary.

If the Clerk of Works pays this visit to the steel works with the engineer or architect, he can see that the steelwork is made up in such sections as can be brought readily on to the site. He must see that provision is made for the reception of it on the job, *i.e.* that there are doors or other openings left high enough to pass the steel sections through, or that it can be hoisted to its position from outside the walls.

In putting the sections together on the job he must insist on riveters being sent to the job if bolts are barred by the specification. Where bolts are used he must see that they are really bolts and not two dummy heads partially screwed in on either side, also that those used are true Whitworth thread, with solid head (not welded), and are sufficiently long to slightly project beyond the nut when screwed up, also that the nut fits the bolt and revolves without wobble.

As regards the actual riveting, it should be watched that the rivet is brought to a dull red heat and that it is forged as speedily as possible.

Protection from rust.

The specification clauses as regards cement grout or paint covering to the steelwork must be noted. Some architects now specify for all steelwork buried in concrete to have a thick coat of cement grout before the fixing; others omit the grouting coat when surrounded by concrete. Steel which is to be exposed should have a coating of paint before leaving the steel works.

It must be seen where painting is specified that the steelwork is freed from scale and rust, the former being removed by using stiff wire brushes, and the latter by steel scrapers. It is important to see that no moisture or grease is on the work at the time of painting, as the moisture will allow corrosion to set up, which will spread behind the coat of paint.

The coat of paint given at the steelworks is often so thin and of such poor quality that even by the time the material arrives on the site, it is showing signs of rusting through, and it is well, when the specification demands, that the steelwork shall be given a coat of paint before fixing—when required. It is of the utmost importance to see that the steelwork is properly cleaned before repainting, and this can be effected by scrubbing or scouring the surfaces with pumice stone, or emery and pumice powder, but it is then, as previously mentioned, essential to see that the water or moisture from the scrubbing is entirely removed.

This can be carried out by going over the surface with a blow lamp. Another good method is by sand blast, but unless the steelwork is on a large scale, contractors cannot be called upon to use this method: in either case the painting should immediately follow the cleaning.

Work in cast iron.

In the inspection of cast-iron items, air holes, which may have been plugged up with stopping, may sometimes be detected by lightly hammering the casting, also the hammering may reveal a rough or uneven surface, which has been faced up with hard sand blackleaded over. It must be looked to that there are no cracks or flaws ; the latter may occur at angle brackets, stiffeners, or lug connections. The casting should be straight, without curve or twist, and of the correct dimensions as shown on the detail drawings. When callipers can be used they will show the thickness of the metal, and where the use of these is impracticable a small hole can be drilled on one side to ascertain the thickness.

If the specification states that the columns are to be cast vertically the only way the Clerk of Works can satisfy himself as to the carrying out of this clause is to personally inspect the pit and not to allow the column to be taken out of the same until after his visit. All surfaces of cast iron which have to be machined should be the bottom of a casting, as the upper part of a casting is the more likely to be spongy.

In the fixing of the columns and stanchions, it must be seen that they are truly bedded and upright.

If separate mouldings have to be screwed to columns, they must be securely fixed, and the Clerk of Works should ascertain the accuracy of the fitting of the two halves or more sections before the actual time arrives for them to be fixed on.

In the hoisting of stanchions, columns, trusses, and girders, the Clerk of Works will watch the method undertaken, in order to see that the tackle is strong enough for its purpose, and that no damage is caused either to the steelwork or to work of other trades.

The Clerk of Works will see that the bolt holes in the lugs of separate castings, which have to be bolted together, are as accurate in form as possible, as otherwise it means using smaller bolts, or else the likelihood of fracture of the flange by the driving hard in of the bolts. In some cases it may be best to omit the holes in the casting and to have them drilled on the job, when absolute accuracy of position can be obtained.

The cast iron items in a building are generally columns, brackets, cantilevers, gutters, pipes, cisterns, baths, balusters, staircases, porches, verandahs, gates, and railings.

Notes on columns have been given, whilst the general notes as regards correct sizes and freedom from flaws, cracks, and holes apply to all other items. Some further notes on gutters, rain water, soil and drain pipes, baths, etc., will be given under the heading of "Plumber."

As regards staircases, porches, verandahs, gates and railings, these often form separate contracts, or provisional amounts are allowed in the quantities for same. The Clerk of Works will have to see that the castings are clean and properly erected. They are usually fitted at the works of the firm supplying before delivery, and it is advisable for the specialist firm's own workmen to fix.

With reference to verandahs, screens, canopies, etc., these certainly should not be allowed to be fixed until the scaffolding is taken down, in case of accidents in the removal. When, however, the scaffold is essential to their erection, every care must be taken to avoid anything dropping on to the work under, and, if necessary, special protection boards or sheeting must be insisted on.

In the case of railings, whether wrought or cast, they also should not be fixed until the building scaffold is struck: if to a road having a gradient, the Clerk of Works must see that the rise shown on the detail is correct before the work is put in hand, and should carefully check lengths between piers and gateways, especially where variations on the original planning have been carried out. If the railings are fixed with lead, he must see that this jointing material is brought up flush with the stone base or plinth, as otherwise water will stand in the sinking, and the lead will eat through the iron in the course of time.

It is very essential to see that the gates are hung so as not to bind, which may happen if the hanging stile has the least play. When this occurs the Clerk of Works will have to consider additional fixing, or back or side stays may be found necessary, and the architect must be written to for instructions.

It will be essential to see that the proper sized templates are put where specified or shown, and that stout boiler felt seatings are inserted when mentioned.

The firm supplying should number or letter each joist according to that on the contract drawings, or if necessary supply a key plan to the lettering they put on.

The Clerk of Works will keep notes of the dates of delivery of steelwork; it is often the cause of delay, and such notes may prove very useful, as the steelwork may determine the progress of the work.

CHAPTER XII

THE SUPERVISION OF PAVINGS AND RENDERINGS

THE use of concrete for pavings, landings, and stairs is now becoming general in construction where fire-resisting and cleanliness, as conditions, are desired.

The materials for and sizes of concrete vary according to the particular purpose of the paving, but the most common is of granite chippings broken to specified rings.

With all concrete, whether in foundations, floors, or pavings, the idea in view is the perfect homogeneous mass, and some notes on how this may be obtained have already been given in previous chapters.

Pavings will vary in thickness and finish according as to whether they are for horse, wheeled, or foot traffic. The Clerk of Works will determine first that the proper depth of earth, etc., has been removed, and that the soil is in a fit condition to put down broken brick or stone hardcore upon, and before any materials are laid down he must have decided—if the drawings or specification do not distinctly show or specify it—the point to which the pavings are to fall, and that provision has been made to take their surface water off.

Where the falls in pavings are not specified, it is well to obtain for pathways to roads a fall of at least $\frac{3}{8}$ inch for every foot in width ; for yards and areas this may be reduced to $1\frac{1}{2}$ inch in 10 feet, but these falls have often to be altered to suit the particular circumstances of the position. In lavatories, urinals, or stables, where it is essential to drain away quickly any urine or liquid from droppings, there is a need to increase this fall, and $2\frac{1}{2}$ inches to 3 inches in 10 feet should be obtained where possible. In basements or floors below the level of sewers, not drainable, the floors should generally be laid level, as these will have to be mopped up, and there is then no object in having a fall.

The Clerk of Works will see that pegs are put in to the correct levels, and will check the accuracy of these himself, and once checked and approved, they must not be moved or disturbed.

The Clerk of Works must ascertain the kind of finish required, as yards may require to be grooved for foothold, and internal floors crimped (though this last finish is not often specified now, and is not so clean and hygienic as plain floors, as the indents hold the dirt and dust).

The specification will probably state where the granite chippings are to come from, and the size of the ring these are to pass for the bottom and top parts of the paving. Samples should be sent to the Clerk of Works for approval.

Hard core bottom.

The ground when excavated should have the hard core, which may be of broken brick, stone, or clinker, put in at once, particularly so on soils which soften considerably either when exposed to the weather or when water is allowed to accumulate and stand. The Clerk of Works will see that he has the specified thickness (which is usually 6 inches) of this hard core put in. This hard core should be broken to pass a $1\frac{1}{2}$-inch ring in all directions, and must be well rammed, and it should be left approximately level, so that the concrete bed will be of an even thickness.

The foreman will try, perhaps, to argue that a level surface of hard core is not essential, as the unevenness will be made up with concrete—a harder substance—but the Clerk of Works should be firm, and insist on an even thickness of both hard core and concrete, as the varying thickness — thick in one place and thin in another—is one of the most frequent causes of cracks in concrete pavings.

Maximum area for bay.

Where a maximum area for the bays or sections is specified, the Clerk of Works will see that this clause is observed. The necessity of bays is to allow the concrete to expand and contract, as all concretes will do—so that no two adjacent bays should be in hand at the same time; furthermore, these bays allow of the workmen getting about the work more easily. When the size of the bays or sections is not given, one of about 6–8 feet long by 4 feet 6 inches wide is a convenient one, as workmen can reach 4 feet 6 inches from the knees, and where bays are next walls, this width should rarely be exceeded; where, however, there is a large quantity of paving, and bays can be worked from two or more sides, there is no objection to bays of 60–72 feet superficial.

Where the specification demands expansion boards or slips at stated distances, these must be put in, and upon removal the spaces must be filled up with fine concrete and the surface finished off.

Mixing and laying.

The Clerk of Works will supervise the mixing of the concrete (notes have previously been given). It should be mixed twice dry and twice wet. The whole of the paving in one bay should be laid in one operation, *i.e.* the top layer should immediately follow the under layer, or otherwise the two will not form a solid bed—the top one not adhering to the lower one. The specification for the lower layer may be 4 or 3 to 1, but the top layer, which may be of 1 inch or $1\frac{1}{4}$ inch thick, and is composed of the finer materials, should not be less than 1 to 1. For the best work the granite chips for the top layer, at any rate, should be washed to remove the dust from the chippings, but from many of the Leicestershire quarries the materials come in already washed.

When for some reason the two coats cannot be laid simultaneously, the Clerk of Works should watch that the bottom layer is well brushed and wetted prior to the surface one being laid on the following day.

Where the work has to be crimped, the top concrete layer will require to be fatter and finer to obtain a good finish, and the paving must be caught at the proper time, after the second trowelling, for the work to be well done.

In all concrete pavings the work should first stiffen, and then be brought to a true surface, and be left from the wooden float, as securing a paving giving a firmer grip to the tread, than when finished with the steel trowel. The finished face should be kept damp for at least seven days, being watered as required by means of a rose-mouthed watering-can.

In grooved work the lines should be accurate, and the squares of true form. If the chalk lines are truly marked and worked to, good results should follow. In marking out the grooves it will be necessary to catch the concrete when it is fairly stiff.

For external pavings, protection from the sun and from winds and rain should be provided.

Most of this class of work is now generally executed by specialist firms, who can be left to their own methods of laying, but the finished surface and subsequent watering will require the attention of the Clerk of Works, who will also have to see that proper and ample protection is given to the floors and pavings on completion.

For wood block and asphalt floors a cement ground will be required. The Clerk of Works will note the specified thickness and gauge of the rendering. It may vary from $\frac{1}{4}$ in. to 1 in. in thickness. The gauge should be one of Portland cement to one of washed sand. He will see that the surface of the concrete to receive this ground is well brushed to remove dust and dirt, and that proper dots are levelled in and screeds formed to the top of these dots. In no case should the asphalt or wood-block flooring be laid until this cement floated work is *quite* dry.

Asphalt work.

The asphalt for roads, floors and flats may differ. Where heavy traffic on roads is anticipated, compressed should be laid, but for basements, floors and other similar surfaces mastic is generally put down; and as regards the roads, unless compressed is specified, the Clerk of Works should consult the architect as to its use for these.

The asphalt is generally specified to be from some particular maker, and if the builder desires to use another maker's he should be instructed to submit the name of the firm to the architect. Where recognised firms are employed to do this work, the Clerk of Works will only need to limit his supervision to seeing that a proper thickness is obtained, and that it is put on in the specified number of coats. In every case, whether as rendering on walls or as floors, wooden screeds should be insisted on—it is the only way to ensure the correct thickness—the Clerk of Works should himself check the thickness of these screeds. If the Clerk of Works has any suspicions as to the thickness of the rendering, he should have a piece cut out, and must remember, in measuring its edge, to do so perpendicular to the surface, as it has most probably been cut out with a slightly bevelled edge.

With asphalt for paving purposes we have different principles from those that govern ordinary cement or solid pavings, as the former can be looked upon as a fluid paving. The elasticity of asphalt at all temperatures is an important point, so that the cementing part of it may so surround the grit of the material that it is pliable when subject to traffic, and will not be ground away or crushed by wheels of carts and vans at any temperature; nor yet soften at the higher temperature; yet at the same time it must be ductile enough not to crack at the lower ones. It must also be dense enough to prevent water finding its way into any spaces that may exist, or being pressed in by traffic passing over the paving; and, lastly, the paving should last a number of years before it loses its pliability by the hardening of the mass or by the case hardening of the surface.

When the work is done by the specified firm, the Clerk of the Works can take it that the architect knows the quality of the work they execute, but where local firms are suggested as substitutes by the builders, he should ascertain particulars of work, near at hand, that has been put down by the proposed firm, together with the approximate date of laying, and should note its condition, and send in his report to the architect for his information, basing the same upon the points of good asphalt just mentioned.

Other points the Clerk of Works will have to look to are the putting in of angle fillets to all angles, horizontal and vertical, also the finish of rounded angles, and to the tucking in one 1 in. into the brickwork the top edge of the rendering.

Careful notes or sketches should be made of any variations or external rendering which will be hidden by returning the earth outside the walls, and he should insist on no earth being filled in until he has inspected the rendering, angles, etc.

As in cement pavings, the levels and falls must be carefully worked out and checked by the Clerk of Works. If channels or gutters are required, these must be previously made in the concrete and cement ground.

Space for asphalters to work in should not be less than 2 ft. 6 in. wide. It should be done from the face side, and no overhand work allowed. If this working space is not taken in the quantities, notes or sketches should be kept of that actually got out, for adjusting at the time of measuring up the variations. Where asphalt ends on a flank wall, a vertical chase in the brickwork should be cut, and the edge tucked in.

Tar paving.

Another paving frequently used is tar paving. It should be laid in dry weather, and the spring season is preferable. For tar paving, the Clerk of Works will note of what materials this is to be formed. Granite does not take the tar as well as a broken limestone, the latter being more porous. A prepared coal tar is used for coating the macadam which must be quite dry at the time of coating in order that the tar may penetrate into the material. Here, again, it is usually supplied and laid by specialist firms.

The material should not have been recently tarred, as it is best for six months to elapse between the heating and covering of the stone with tar and the laying of same.

The Clerk of Works must observe that the proper levels are maintained, and that the material is well rolled and consolidated. The top layer will be of a finer mixture than the bottom one, and the top surface should be covered with fine crushed spar, and well rolled. For paths next grass, or other positions where the material will not be solidly contained, stout edgings should be put down, and these, when levelled and checked, form grounds for the rolled surface to finish to.

Notes on asphalt rendering have been given above; some on Portland cement rendering may be useful.

Portland cement rendering.

The Clerk of Works should see that the sand for this purpose is clean, and for this work it should be washed. The gauge should not be less than three and one, and as with cement mortar, none that has begun to set, or that has been mixed for one hour, should be allowed to be used, so that only small quantities should be permitted to be mixed up.

Rendering does not well adhere to fletton bricks, but these can now be obtained with grooves for key, and where the main walls are to be built with bricks of this class, the Clerk of Works should insist on the grooved ones being supplied and put into those faces which have to be rendered. With ordinary bricks the joints should be well raked out as the work proceeds.

One of the greatest eyesores to cement rendering is the stopping of putlog holes, which generally show for some time after the completion of the rendering. In new buildings these should be stopped up as early as possible with hard bricks set in some quick-setting cement, and the stopping of these should be quite dry before the cement rendering is put on. When cement rendering is put on to old buildings, it is best to put up an independent scaffolding, and so avoid the need of putlog holes.

The Clerk of Works will see that the walls are well brushed down to remove dust, and are well wetted with clean water to permit the cement to set properly, and to avoid the dry bricks absorbing the water from the rendering.

Mouldings should be formed on solid brickwork built out as a core; dubbing out for large projections is not always satisfactory. If the specification states the mouldings are to be in a differently gauged material, the Clerk of Works will see that a separate gauging is made and used. He should also check the moulds.

It is important to see that in large projections, such as cornices, modillions, etc., ample provision is made for upholding these, and that their support is not merely adhesion.

Quoins, rustications, etc., should be looked to, to see that they are of the proper depth, length and height, and that both sides of window and door openings, niches, etc., are symmetrical in the setting out.

Unless the first or flanking-in coat is properly executed, there is a likelihood of the fining coat not being satisfactory, so that trueness of surface, angles, quoins, etc., must be seen to in the first coat. It is also necessary to see that a sufficiently good key is left on the first for the second coat.

The fining coat should certainly not be less than two to one; the former of a fine washed sand. The under coat must be well brushed and wetted prior to the finishing one being put on. If the coat has to be marked for joints, it must be seen these are put on in correct positions, and marked truly horizontal and vertical. and that those to arches are struck from the correct centres.

The sun and rain should both be kept off the green work, and the Clerk of Works should insist on tarpaulins or other protection being afforded as is required.

CHAPTER XIII

THE SUPERVISION OF SLATING AND TILING

Approval and tests of slates.

Samples of slates should be sent to the Clerk of Works for approval several weeks before the builder desires to order them. The specification will give the neighbourhood from which they are to be obtained, together with size required, the lap to which they are to be laid, and the number and quality of nails to be used. As regards the slates themselves, it must be particularly noticed in the specification what quality is demanded, as on steep roofs or ones on which there is no contemplated traffic by men cleaning out gutters, cesspools, etc., or telephone men repairing or extending lines, a thinner or best quality slate is preferable, but on roofs having a pitch of 35 degrees or under, or on which the before-mentioned conditions may obtain, thicker or second quality are best; but, of course, where a quality is specifically mentioned, that which is asked for must be supplied. Also, it is well to note the rule that the steeper the roof the smaller the slate.

The slates should be of even thickness, of uniform colour, with parallel sides for their whole length and width, and be free from blotches and veins. They should be tough, hard, and emit a metallic sound when struck lightly with the knuckles, as against the dull sound of a bad and soft slate. It is said that a slate which, when breathed upon, gives out an earthy smell is one not likely to weather well, but it is better to test a sample slate for its absorbing powers, which can be readily proved by immersing it in a bath of water, having previously weighed it, and then weighing it again after twenty-four hours' soaking.

The percentage of absorption should not be more than 1 per cent. of its original weight, *i.e.* when dry. Another ready test is as to how it will hole and cut under the zax—it should neither fracture, shiver nor splinter. A good slate will hole cleanly, and also show clean edges after cutting.

The size mentioned in the specification should be obtained, but if the builder asks to be permitted to use another size, his application should be submitted to the architect for approval. It is not always possible to get the same size slate unless at an enhanced price, consequent upon the waste in cutting to the specified size, and really the question of size is not of paramount importance, so long as a proper lap is obtained; but the whole of the slating to one side or parts forming a separate slope, must be covered with the same size slate, as it is very necessary for appearance sake to keep the perpends true throughout the slope of the roof.

The Lancashire and Westmoreland slates must vary in size, and require sorting after delivery into lengths, and these will be laid in graduated courses diminishing from eaves to ridge. Stouter nails should be used for these heavy slates.

Slate nails.

The nails to be used will be mentioned, and possibly the weight per thousand. The Clerk of Works will check both kind and weight of those brought on to the job. For London atmosphere and for stables generally zinc nails should not be used, nor yet for buildings to be used for the manufacture or storage of chemicals, gas, etc., owing to the fumes of sulphur decomposing zinc rapidly. Copper nails yield practically lifelong wear and use. Where these last are specified, it will be well for the Clerk of Works to see, by cutting through one or two, that those on the building are of that metal and not a cheap alloy.

For composition nails a sample should be inspected, as some are so soft as to be useless.

Workman-ship.

Leaving the subject of materials for inspection of work, the first point for the Clerk of Works to note is that the roof level is really reached; it is not unknown for three inches or more to be stolen from floors having high rooms, with plain walls, and where dressings do not easily show the height reached He should have gone carefully into the question of the slating at the time of working out for his own information, all the details of the roof construction, including form, shape, and method of conveying water from every part of the roof coverings.

If this has been thoroughly done, there will only be the actual supervision of the slating work proper to occupy his thoughts at the time of the arrival of the slaters on the job, so far as the roof is concerned.

The plumbing work, so far as is necessary to prevent walking on or damage to the slating work, should have been done prior to the commencement of the laying of the slates; and the guttering also should have been fixed. The plumbing work to roofs, etc., and guttering will be described in the article on supervision of external plumbing work.

The Clerk of Works should note how the verges are to be finished, so that the end slates can be left overhanging sufficiently to allow for pointing and hiding the ends of any of the woodwork. It may be necessary where the timbers do not extend to the face of the wall for the end slates to be bedded in cement. The slating at alternate courses at verges should be out of slate-and-a-half slates.

It must be watched that the lines are horizontal, which is easily effected if the chalk line is used properly. The Clerk of Works should himself check the gauge stick.

The double course at the eaves will be inspected, to see that it is of proper depth, and generally the Clerk of Works will see that the cuttings round openings, gutters, hips and valleys are neatly executed, and that where close cut and mitred hips are specified the workmanship is good, and that the slates to both hips and valleys are securely fixed.

The question of the lap is the most important in supervision; the builder under no circumstances is to diminish upon that specified. It must also be seen that each slate has two nails, and that no slate spoilt in the holing is reversed end for end, reholed and used. No slates should be deliberately nailed through the lead work.

Where slate ridge pieces are used, it must be seen that they are firmly bedded in black hair mortar, and fixed securely, and that when in two pieces a good joint is made between the one piece and its covering piece, with the holes for screws effectively stopped with white lead.

Supervision of tiling.

With regard to tiles and tiling, the specification will most probably specify what firm are to supply or the brand of tiles to be used, perhaps giving descriptive colour, etc. The tiles should be free from twist, lamination, straight in their width and slightly hollow in their length so as to lay well; in fact, tiles which are straight in this direction may well be refused, as they will not lie close on the back of the undercourse.

If handmade tiles are specified they must be obtained. They are generally thicker and consequently heavier than machine-made ones, but all the tiles should be without twist, and upon being cracked should show a fine grain, free from stones, and the vitrification should extend right through. When lightly struck they should give out a clear ring.

If the approval of the tile is left to the Clerk of Works he should ascertain buildings at which the ones suggested for use have been employed, and how long they have been in position. The brightness of colour of sample tiles should not mislead him, and of two submitted, that which absorbs least will be the best for use, but tiles weather, and that weathering acts as a protection against absorption of rain after a time, so that the absorption test alone should not be looked upon as final in determining the approval of a sample submitted.

All of the notes given above for slating apply equally for tiling, but if any of the tiles, as, for example, those to secret gutters, etc., are to be bedded in mortar, it is important to see that the bed is thin, and kept back sufficiently far from the edge of the tile to prevent water being drawn in.

Seeing the narrow width of plain tiles at the verges, hips and valleys, the builders should be called upon to put in tile-and-a-half or double tiles, to avoid the need of very small pieces. Where purpose-made hip tiles are specified, they should fit the slopes of the hips, and be firmly fixed.

The ridge tiles should be of the correct angle, and be firmly bedded in hair mortar. The Clerk of Works must see that the cutting to these, where necessary, is neatly executed.

If for any purpose a roof, formerly proposed to be covered with Welsh slates, is afterwards varied to tile covering, it may mean diminished spacing of rafters, or the increase of the size of those put in on account of the extra weight.

Upon completion of the slating and tiling, the Clerk of Works must see that the lead and iron gutters are left free and clear from broken slates, cuttings and nails, and that the slating is in perfect condition, having no broken or cracked slates or tiles anywhere, that the flashings and aprons are properly dressed down, and the pointing to verges sound and complete.

CHAPTER XIV

SUPERVISION OF PLUMBING WORK

External Work

THE plumbing work is conveniently divided into external and internal, the former being chiefly coverings and precautions taken to keep water and weather out of a building, whilst the latter includes means of bringing water into the building, for drinking or domestic purposes, and of taking away wastes, overflows, and the provision of ventilation and antisyphonage pipes to fittings and wastes.

This division into external and internal is the method and order adopted by the quantity surveyor when taking off dimensions and writing his bill, and can be followed here for notes on supervision.

When the Clerk of Works goes into the question of roof coverings, at the time of looking into the details of carcasing construction of the various roofs, he naturally deals with the question of the leadwork to same; so that before the plumbers arrive he knows in his own mind at least, and he may have directed the foreman accordingly, exactly how and where the leadwork is to be laid; he is therefore on their arrival at once prepared to check and supervise their work, without causing any delay by having to "go into" the matter at that time.

The draughtsman who prepares the drawing does not always see the best way of construction, nor yet of carrying the water away, and it is open to the Clerk of

Works, as being the man on the spot, to *suggest* another when a difficulty or objection is seen to that shown, but it will be too late to suggest an alternative when the plumbers are in possession, or even when the carpenters have put in the gutter boards and bearers, as shown on the drawings. All these gutters and flats must have been thoroughly gone into in detail and settled before the carpenters are ready to commence on them.

Assuming the constructional details are completely settled, the supervision of the external plumbing work is merely that of noting that the correct weight of sheet lead is employed, and that it is put in of the proper width and safe length, and is securely fixed.

The experienced Clerk of Works can tell by the eye and by the "feel" the weight of a piece of sheet lead—by the manner and ease of bending with the fingers and thumb; but a certain test is to weigh up pieces say 6 ins. by 6 ins., which should weigh one-quarter of what is specified per square foot, so that sample pieces would in 6 lb. lead weigh $1\frac{1}{2}$ lbs., and other sizes in proportion, as the builder may not be willing to cut out pieces 6 ins. by 6 ins. often.

Each whole sheet when delivered is stamped with a weight, and the Clerk of Works can check it by weighing it, taking its superficial area at the same time. The specification will probably state it is to be "weighed at the contractor's expense when required," but even when this clause is non-existent, the Clerk of Works should have pieces weighed up when he is suspicious, and is unable to determine its correctness by the "feel."

Where the Clerk of Works knows the correct thickness of sheet lead according to the weight, he can check any piece he is in doubt about by means of his calipers, and as in asphalt rendering, etc., have the piece cut truly square at its edge, with any burrs scraped off, before applying these.

The specification may state the longest length of sheet lead to be used, *i.e.* between drips or rolls. The Clerk

Spacing of rolls, etc.

of Works will see that such a clause is adhered to, also that rolls are equally spaced on flats, and that the lead is turned over the roll about two-thirds of its surface ; it should not go over and lie on the flat on the other side. He should note that these overleads face away from the direction of the prevailing rains.

The drips should be two inches at least in depth, and not more than ten feet apart, and the falls should never be less than an inch and a half in ten feet ; but where directions are given in the specification, these must be followed.

The Clerk of Works should see that each sheet laid is free to expand and contract, and no sheet of a larger size than forty square feet should be allowed, and no sheet should under any circumstances be longer than eleven feet.

Soldering to external plumbing work should not be allowed, except in such places as cesspools. Bossing should be insisted on where practicable.

Gutters, flushings, etc.

Other points to note for supervision are the turn up of the sides and ends of lead gutters. It must also be seen that they are of the proper depth, and that the lead lies sufficiently far up the roof under the slates. The gutters should not be less than nine inches wide at the narrowest end, unless absolutely unavoidable, as at times of clearing out of the gutters this width is reduced to about seven and a half inches (owing to overhang of slates) for foothold for the cleaner, which is none too much.

The flashings should be about four and a half inches wide after inserting into the joints of the brickwork, and should cover the lead turn up of the soakers or gutter sides by at least three inches. The flashings should *never* extend down to the slating.

The turning in of the flashings should be at least one inch—often an inch and a half is specified. Where flashings occur in stonework or in terra cotta they will be burnt in. The flashings must be securely wedged up with lead wedges and be pointed in cement mortar.

The Clerk of Works will see that the wedges are efficient and sufficient in number, and that the facing bricks are not spalled by the carelessness of the workmen in wedging up. Damaged bricks should be cut out and be replaced with new ones. In the cover flashing it should be seen that the specified lap is given, which is usually four inches.

The cover flashings will be made secure by means of lead tacks. These should be of 6 lb. lead, and in exposed positions, as on hips, etc., be out of 7 lb. lead. These tacks, after being firmly fixed themselves, should be long enough to turn up on the face of the cover flashing, aprons, hips, etc., two inches, and it should be seen that the tacks are closely dressed to the leadwork it is holding down. If the width and position of these tacks are not specified, they should be made not less than two inches wide, and be spaced three feet six inches between one another.

Soakers and cesspools.

The soakers should be inspected before they are handed to the slaters, for correctness of size (for underlie of slates and turn up next walls), shape, and weight of lead they have been cut out of, and before the flashings are wedged in and dressed down, it should be noted that there is one soaker to each slate or tile.

As regards cesspools, the Clerk of Works will note that these are of the size mentioned in the specification, are well soldered at angles, and that the socket pipe is properly tafted and wiped to the same. He should notice that the socket pipe is of the correct weight and is properly bent without indentation.

Workmanship.

The Clerk of Works will particularly note that all woodwork to receive lead which may be subject to walking over by workmen engaged on repairs, is traversed prior to the laying of the lead, and that gutters, etc., are cleared of shavings and nails. It will be necessary for the Clerk of Works to note how the lead to dormer sides or cheeks is to be fixed—if by soldered dots it must be seen that the hollow in the boarding is neither too deep nor too large, and is as smooth as a cut grain surface can be, also that the lead is well dressed into the sinking (which should be in the boarding against a stud where possible). The screw to secure the lead should be of brass with a copper washer under its head. The dots should be neat in appearance, and flush with the surface of the leadwork.

Where secret fixing is demanded, lead tacks will be insisted on, and it will be necessary to see that the boarding is hollowed out to receive the tack when it is soldered to the back of the lead covering, as when this is omitted to be done, the surface of the dormer cheek has a bad appearance. Where the edge of the lead covering to the cheeks of the dormer is to be turned into a groove in the dormer frame, it is well to see that the groove is run before the frame is fixed. The edge should be copper nailed and bedded in white lead.

The lead used for coverings to rolls or ridges, hips, or on valley boarding must be looked to, to see that it is of the correct width, and is firmly secured by proper tacks. If it is specified to sink the roll for the lead passings, the Clerk of Works will observe this is done. The laps should not be less than six inches, nor should the lengths of the pieces be more than ten feet. The upper ends should be copper nailed for hips and valleys.

Coverings to cornices, etc.

The other external plumbing work as coverings, as distinct from pipe-work, is the protective covering generally put to stone cornices, strings, and canopies. For ordinary positions upon which workmen are not likely to stand or walk for cleaning of gutters and windows, or repairs to slating, 4 lb. lead is considered ample, but where traffic is likely at some time to be permitted 6 lb. lead should be put on. If no such covering is shown or specified, its use should be suggested to the architect.

The Clerk of Works should note the thickness of this covering, that the lead dots are properly and neatly put in, and are of the weight specified (if any), and that the necessary welts are made and the chases in the stone properly executed. The down-turned edge of the lead should be slightly dressed outwards from the stone.

All exposed edges of leadwork, whether in hips, flashing, or stone covering, should be neatly trimmed to show equal margin.

Iron gutters and pipes.

The guttering and rainwater pipes, soil and other outside lead and iron pipes, must be dealt with here in these notes, as coming under the external plumbing work. There is not much to supervise in the guttering and rainwater pipes where of iron, except to see that they are of the proper thickness or weight, with the specified ears. collars or holderbats, and that the fixing of them is correct and substantially executed. If hard wood plugs are specified, they must be used. It should be seen that each hole has a gutter bolt and nut, and that the joints and holes are watertight.

It must be seen that the gutters lie flat against the fascia (being free from burrs or hardened sand coated over), and are securely screwed to same, that the fall is efficient, that proper stop ends are provided where required, that outlets are of proper size and in their correct positions, and that the return ends are truly square, and all bends of pipes are of the proper degree.

Where the rain pipes are of lead, they must be of correct shape, design, size, thickness or weight, and be free from indentation. It must be seen that the end of the one enters sufficiently into the head of the other.

The rainwater heads of lead must be to the architect's design and equal to the specified weight. The foreman must be instructed to see that they are not damaged either before or after fixing. It is unusual to paint lead work, so that strict instructions on this point must be given, as regards lead pipes, heads, etc.

Iron rainwater pipes, heads and guttering must be painted before and after fixing, and the Clerk of Works will see that the inside of the last two is really painted the proper number of coats. If galvanized or Angus Smith coated pipes are specified, it should be seen that they are put in.

All heads and outlets to gutters should have strong wire (galvanized) or copper wire domical covers. If a gauge of wire is specified both for the frame and the filling, it will be necessary to check both parts of the covers, and to remember the gauge is to be that of the wire before galvanizing, as all galvanizing should, whether on wire or on sheet, be done after manufacture.

The lead soil pipes will require to be weighed in order to check the weight per square foot they are equal to, also the diameter must be checked.

External pipe work.

The method of fixing must be looked to, and no indents of the pipes should be allowed. Where the architect has furnished a table of tacks required for each size of pipe according to whether it is fixed vertical or horizontal, and giving the number of screws to each and the kind of plugs, etc., the Clerk of Works has an ideal guide to aid him in his supervision.

Where no such list is given, the Clerk of Works should frame his own from the information on this matter (if any) given in the specification, and he can submit the same to the architect if he is in any doubt as to its accuracy, but using his own judgment and experience when preparing such a table, there should be no need for him to worry the architect upon such a small matter, for he should never lose sight of the fact that he is there to *relieve the architect of unnecessary trouble.* Having given or framed a table of number, size, and description of tacks, for each size of pipe, he has but to see that its requirements are observed, as regards number, spacing, and method of fixing.

The position of the soil pipe will have been determined early in the work. Its run from top to bottom should be as straight as possible. Where bends must occur or junctions enter, it may be advisable for cleaning caps to be inserted, and if not specified (the need cannot always be seen by the draughtsman) the architect's attention should be drawn to the need, if any exists, but it must be seen that the full bore of the pipe is not obstructed by careless workmanship in putting these in—the internal surface of the cleaning eye should be circular and of the same radius as that of the pipe.

All joints in soil or other lead pipes must be wiped, and no blown joints should be allowed, and neatness of execution of these should be insisted on for any and every size of pipe. In the joining of the tacks to the pipes a sufficiency of solder should be employed.

Where soil pipes have to be of cast iron, the weight per certain length is sure to be mentioned in the specification. The Clerk of Works will see that proper size and weight pipes are supplied, free from cracks, and having a bead on the spigot end. The fixing and jointing of these will require attention. It is usual to keep these off the face of the wall, which may be effected by wrought-iron tube distance pieces, hard wood shaped blocks of the required thickness, or by shaped holderbats.

The Clerk of Works will note what is specified, and obtain it. He will also observe that the collars are strong and deep enough for caulking. The jointing should be by means of caulked lead rope, or lead shavings so as to centre the pipe accurately and prevent the molten lead from running through. This last is then caulked to close out any air spaces left by the cooling of the run-in blue-lead. It should be filled to the end of the socket, where it should finish neatly. It should be observed that when old lead is used for the joints, all impurities should be got rid of by allowing the pot to become red hot. The impurities can then be skimmed off.

With cast-iron soil pipes, the junctions being also of that metal, it is important to see these are as near as possible the requisite angle, unless purpose-made are specified, when exactness can be insisted on.

The Clerk of Works will see that proper connections are made between lead and iron soil pipes and stoneware or iron drains, with proper brass or gunmetal sleeve pieces or ferrules where required.

The notes given for lead soil pipes apply equally to ventilating, antisyphonage, and waste pipes, but as regards the last, it may be that expansion joints are specified for those conveying heated water—if so, the Clerk of Works must be prepared to show the builders what he requires in this direction, if the specification does not give the necessary information.

The Clerk of Works will note that the ventilating pipes terminate in suitable positions and at proper heights, and are securely fixed with stays where necessary. Where pipes go through slated or tiled roofs, proper lead slates must be provided.

Internal Work

The internal plumbing work will consist mostly of water services and wastes from fittings, and the Clerk of Works' principal items of supervision will be to see that the specified weight of pipes are put in and the work is neatly and substantially executed.

The weights and sizes of pipes specified may be in accordance with the regulations of the local water company, but the Clerk of Works will have to compare them, as if not, the latter will have to be followed.

Quite early in the job he must decide the runs of the various services and wastes, in order that holes may be left in floors and walls, as cutting holes through finished work is objectionable, weakening in many cases the floors through which they pass. In reinforced concrete work this leaving of holes is very important, as the cutting of them afterwards is often a very difficult and costly matter; with a little forethought, often bolt holes used in the form's construction can be put where they will answer for perforations for pipes.

As regards water services, each service, waste and ventilating and antisyphonage pipe to each fitting should be traced out, and the position of the stopcocks determined. It is generally a saving of time for the Clerk of

Works and builder's foreman to do this in conjunction, as two heads are better than one, and one of them may see an advantage or objection which the other, by himself, might have overlooked. An hour devoted to this settlement of service runs, etc., may save the foreman hours in cutting away, and may also save the shattering of floors and landings, by the jarring caused by punching holes when the work is set.

Fixing of pipes.

The method of fixing the pipes, with number and size of tacks, and the intervals of these last, with the number of screws to each, will be given in the table suggested on external plumbing supervision.

Where pipes go through principal rooms it is possibly specified for these to be enclosed with casings; if this is so, the workmanship to such pipes must be equal to that of exposed pipes—the putting up of casings is often made the excuse for careless execution of joints. It may be advisable where pipes on staircases or passages are likely to be damaged to case these also. If not so specified, the Clerk of Works should consider the necessity, and if the need exists, suggest the casing to the architect.

The casings should be put up with brass cups and screws, to admit of the uncovering of the pipes rapidly and easily, without damage to the adjacent plaster work or papering.

Cisterns and safes.

The Clerk of Works will see that provision is made for easy access to cisterns in roofs, by means of trapdoors in ceilings; also that deal rough-boarded runs are put to and around the cistern to permit of workmen walking safely, at the times of cleaning out of the cisterns, without the likelihood of the key of the plaster to the ceiling being broken away from the laths. If these are not specified, permission must be obtained for their insertion, and particulars kept of what is actually laid down.

In selecting the actual position for the cistern it must be borne in mind that it will, at intervals, be cleaned out, so that its position should be where daylight is obtainable for the men to work by. A skylight should be put near the cistern, in the roof. Also, its position should be such that workmen can get all around it.

In a large building it may probably be cheaper to have several cisterns than to concentrate the supply to one part of the building only, and where the latter is shown, the Clerk of Works should go carefully into the question of cost for the alternative of having several supply cisterns. It will mean additional cost for the cisterns (which will, of course, be smaller), safes, and brass work, and plumbing to same, but, on the other hand, the services will be shorter, and more direct to the points they are required at, and there is also the great advantage that water is always obtainable at some points in the building, which would not be the case if the concentrated or one main cistern supply failed or needed repair at some time.

The plumbing and brass work to the cisterns will require inspection. The brass work should be heavy and of the description specified, and the workmanship, although probably hidden in the roof, should be as neat and thorough as where in full view.

The cisterns should always have lead trays or safes under them where on wooden joists, floors, etc. The safe should have a rim at least 3 inches high, with the lead, generally 4 lbs., copper nailed to its edge. The overflows of both cistern and safe should be taken direct to the open air in such positions that their outlets are easily discernible. Their size should be at least $\frac{1}{4}$ inch larger in diameter than the supply pipe to the cistern, in case ball valve to the latter gets out of order at some time.

It is very essential to see that the outlet of the overflow pipes is not cut so short as to allow the water from it to run down the face of the walls—it should be sufficiently forward to discharge well in front of walls, and so as to be in full view from ground level. The

Clerk of Works will see that the ends of all overflow pipes have the specified hinged flaps.

If the cisterns are specified to be covered or cased in for protection from frost, the Clerk of Works will watch that slag wool, etc., is really put in.

All cisterns should have a close-fitting cover to same, hinged in part for cleaning purposes.

Where lead-lined cisterns are asked for, the soldering to the angles must be inspected. They should be neatly wiped, and the edge of the lead must be close copper nailed. The Clerk of Works will examine the perforations of wood cisterns and of the lead lining, and note the careful dressing of the latter into the sinking of the former and the connection of the pipes to same.

Stopcocks, etc.

In deciding the run for the rising main or mains, it should be borne in mind that these should be as vertical as possible. Where enamelled iron and other tablets are to be put to all stopcocks indicating their use, it must be seen that the correct one is put to the right cock. There should be a stopcock to each service pipe from the cistern, and to every branch both from the cistern and the rising main, also one to each water waste preventer, to W.C.'s and urinals, and to baths, lavatories, besides the main one to the rising mains.

The Clerk of Works will see that these last are placed in proper guard boxes in readily accessible positions, and that the keys are labelled, and handed over with manhole and other fittings keys, at the completion of the building.

With all buildings it is advisable to have screw-down, draw-off taps fixed inside the building, in such positions that a caretaker or night watchman is enabled to empty all pipes if the necessity arises.

The Clerk of Works will inspect all bibcocks, water waste preventing flushing cisterns, W.C. pans, lavatory basins, etc., to see that they are of the specified quality, size, etc. Where prime costs are stated, he should personally inspect the receipted accounts of the builder's merchants for same.

Approval and fixing of sanitary fittings.

If the approval of the sanitary fittings, as lavatory basins, w.c. pans, etc., is left to the Clerk of Works, he will be guided in his selection by the simplicity and self-cleansing properties of the fitting. Where fittings are not self-cleansing, they should at least allow of being easily cleaned. The basins should be of a strong glaze (if leadless is specified the Clerk of Works must assure himself of this point). The w.c. basin and trap should be such that the flush will cleanse the basin at one charge, and the seal should be good.

If the Clerk of Works visits a sanitary ware manufacturers for the purpose of selection of a w.c. basin, it will generally be found that the firm have types of basins fitted up with flush pipes and with charged water waste preventing flushing cisterns connected to them, in order that they may be able to demonstrate the good points of the basin as regards flushing. A simple test of the self-cleansing properties of the basin will be to cover the inside of the basin with lamp black and to drop on to this a few pieces of paper, so that they lightly stick, then to drop in a few corks or cores of apples, etc., and with an efficient type of basin the whole of the contents will be washed out and the pan left clean. Of course, the type of basin chosen will be a wash-down, and not a wash-out.

In the fixing of lavatory basins, the Clerk of Works will see that they are securely fixed by brackets to the wall, and in ranges that the overlip of the one fits the top of the other, and that the basins do not warp or twist; that the plugs (if any) fit the wastes and act effectively, and that the basins are not chipped or cracked.

In ranges he will see that the proper sort and weight of trap is used, is well connected up and fitted to the trunk waste, that this last has a proper fall, and that the junctions are made (if to lead trunk waste) to lead towards the direction of the fall.

In the water-waste preventing cisterns—if so-called noiseless ones are specified—it will be necessary to see they are put in, and that, generally, proper sized brackets are supplied and fixed. Where a range of closets are put in, it should be seen that the cisterns are all on the same level for appearance sake. They should not have less than 7 ft. head (where this is obtainable). The joint of cistern to flush pipes and flush pipe to pan must be inspected. The flush pipes should be as free from bends as possible. Where windows come immediately over the W.C. and the cisterns have to be on the side walls, the bends must be easy.

The Clerk of Works should aim at efficiency of the flush rather than appearance, which last must always be a secondary consideration in all sanitary questions. Where it is possible to put the cistern over the windows this should be done, letting the flush pipe come down in front of the window, which should be of obscured glass. The cistern must not be fixed too high, to allow of it being repaired or regulated when faulty.

The W.C. must be rigidly fixed to the floor, which itself should be rigid. If the floor is at all springy, the joints are liable to fracture; also, it is of the utmost importance to see that the W.C. basin is fixed level, or so as to allow of the seal being really a seal and effective.

With urinals and other fittings, of which the traps may, of necessity, show through the ceiling of the room below, it may be advisable, where this is objectionable, to put in a raised platform or step. The need for this should be noted early and allowed for in the construction.

Generally, to all sanitary fittings the Clerk of Works will see that they are of the type specified, and are well fixed, trapped, and ventilated as required, the traps having cleaning eyes where necessary. He will see that the supply and waste pipes to and from same are in accordance with the specification, and that the workmanship is of the best and is neat, and that in the branch joints the plumber has not allowed a cockspur of solder to get on the inside of the pipe, where soap, paper, etc., can collect and accumulate. It will also be seen that all joints are in accordance with the local authority's bye-laws.

Final inspection and testing.

Work behind casings generally, either service pipes, or to baths or lavatory basins, should be viewed with suspicion. The main storage cisterns may be of cast iron—if so, it must be seen that they are got in and built up in position before the roof is put on or the floor below ceiled, if they are not always to be exposed to view. Where rust joints are specified, the Clerk of Works will watch the making of these.

The paste is best made of the slow-setting proportions, and is also best mixed one or two hours before required for use. A slow-setting mixture is 2 lbs. of sal-ammoniac, 1 lb. of sulphur and 200 lbs. of iron borings—the latter being pounded up, and the whole of the ingredients mixed first dry and then just sufficient water added to yield a stiff paste after the second mixing.

As regards the drinking-water services, these will be direct off the main, and before any draw-off tap is labelled, the Clerk of Works should personally trace the pipe, to see that it is taken off the rising main and not accidentally connected to a cistern service supply.

Where glazed bricks, tiles, or other facings have to be cut for pipe perforations, the making good should be made to match in colour and appearance the surrounding work.

It is well, if time permits, to prepare a plan showing the water services and waste pipes, indicating stopcocks, draw-off taps, cisterns, etc. The architect will probably supply in a large building sun-prints of the contract drawings specially for this purpose. On it can also be shown gas, fire hydrants, mains, etc., by means of different coloured lines for each particular service. Such a plan is of great use for subsequent repairs or sanitary inspections in after-years.

On the completion of this work the Clerk of Works will see that each cistern, boiler, lavatory, and w.c. basin, bath, etc., is left clean and in perfect working order; that each branch waste pipe is properly connected to its proper main waste, and the branch ventilating pipes to the main ventilating pipe; and that copper or galvanised iron wire domical covers are put to the tops of these last.

Where the specification demands a test of all sanitary fittings and water services, the Clerk of Works will carry this out personally, and in order to ensure that the pipes supposed to be under test are really so, it is well to test only a few at a time.

CHAPTER XV

THE SUPERVISION OF PLASTERING

Avoidable faults.

Too little attention is paid usually to the plastering part of a job by Clerks of Works; beyond seeing to the materials from which it is made and the number of coats that are put on, with a certain class of Clerk of Works little else is done, but there is much to watch beyond these two points.

How often is it seen that when a portable cabinet or cupboard is placed against a wall that it either stands out at the bottom and in at the top, or *vice versâ*, and again, when a ceiling is painted, the finish being glossy, how its surface is shown up to be a series of hollows and ridges.

The former may not be the plasterer's fault alone, as the grounds, studs or partitions, etc., may have been constructed out of upright, but if his dots and screeds have been properly put on and worked to, his work must have been truly perpendicular; but it is not unknown for the studding to be so much out of plumb as to require so much levelling out that the weight of the coating materials would not hang on to the laths in the thick portion, and then the plasterer makes the best of a bad job by screeding his dots as near to upright as he thinks necessary.

The Clerk of Works should have none of this covering up other trades' errors—true, he should have had his eyes open to the faulty construction before, at the time of its erection; but it is not too late, even when the plasterer is second coating, to have it remedied, by the removal of the offending studding, etc., and having it truly refixed.

If the error is on brick main walls (which is, or rather should be, next to impossible, but has been known to occur) the wall in fault should be dubbed out with tiles in Portland cement, and any dubbing out required, where tiles cannot be used, must be with gauged stuff.

Generally, the thinner the coats are the better, as they dry more quickly, and consequently harden sooner.

It will be best if some notes on the materials used are first given.

Sand and lime.

The sand, as ever, must be clean and free from earthy matter, and where screening does not yield a fit sand it must be washed. It is generally considered that river sand is best for plastering purposes. The size of the grains will vary with the coat, as a coarser one can be used for the first coating, the object of which is to put on a fairly even thickness of coarse stuff, which, when scratched, will form a good key for the second coating. For this last, which is to give a straightened surface, a finer grain sand may sometimes be an advantage, whilst for fine stuff a small grain sand is indispensable.

The lime to be used will be mentioned in the specification, generally for plastering—one that slakes with great heat, falling to powder rapidly, is best. The coarse stuff may be of a grey stone or grey chalk lime, but the setting coat lime or putty will be from chalk lime.

If the job is in a locality with which the Clerk of Works is making his first acquaintance, he should have samples of various limes submitted to him by the builder, when by their slaking, setting and hardening properties he can form an opinion of their fitness for use or otherwise.

The laths most commonly used on good work are of lath and a half thickness, and are of Baltic fir. The

Clerk of Works will note that they are free from sap, knots, crookedness, are not too smooth, and, lastly, that they are riven ones and not sawn. The last are rougher on the surface, but are liable to twist and warp, and as the grain has been cut through in parts, are not so strong as the riven laths.

Laths and lath nails.

As regards thickness, lath and a half may be said to average $\frac{1}{4}$ in. thick. The thin ones in the bundles should be used on the studding, leaving the thicker ones for the ceilings. Also, in passages and other places subject to rough usage, the thicker ones should be put on.

If the nails are not particularly specified zinc ones should be asked for, as iron ones rust and discolour the plaster work, for which reason also the Clerk of Works should object to iron nails being used by the plasterer when putting the screeds on, unless it is seen that the screed is below the nail, and the nail is afterwards removed.

Where walls are to be papered the discolouration of the plaster work does not matter so much, but for distempered or painted walls, to have delicate or light tints, it is very objectionable.

The nails should be $\frac{3}{4}$ in. long for single laths, and $1\frac{1}{8}$ in. long for lath and a half thickness. A nail must be put to each end of a lath, *i.e.* the laths should be butted, and never be allowed to lap one over the other, to save nails or cutting the laths. Also the Clerk of Works must see that the laths are laid to break joint, in order to avoid the possibility of the plaster work cracking at one line throughout the ceiling or partition. The ideal method would be to break joint with each lath, but it is only usual to specify the breaking of joints by lathing in three foot bays.

The laths should not be too close together, otherwise a key for the plaster is but poorly obtained, as the riven laths vary in width in parts and the edges are also in parts crooked. Three-eighths of an inch is the best distance apart for all descriptions of lath work. The Clerk of Works should watch this point, as the lather is as likely to place them too close together as to have too much space between them.

The Clerk of Works will have seen that the studding and joists have been fixed at correct distances for lathing purposes. This also applies to bracketing and cradling to beams and cornices. Where counter-lathing is necessary it must be put in.

The Clerk of Works must check the gauge and mesh of the metal lathing supplied, to see that the specification is being complied with, and note it is securely fixed by stout staples to woodwork and by wire to ironwork. In order that a good key may be obtained where expanded metal is put to the soffit of rolled steel joists, it is best to have iron rods put in or let the web of a small steel tee or tees be made to answer the purpose.

Coarse stuff and putty.

The only other material to note is the hair used in the coarse stuff, etc. It should be long and curled, either of cow or goat hair. It must be free from grease or any other impurities. It will be seen that it is well beaten, to break up and separate the lumps or matts. The specification will state the proportions in which the hair is to be added to the lime, usually about 1 lb. of beaten hair to three cubic feet of lime. The hair should be soaked or washed in water before it is put into the lime.

Referring once more to the lime, it is of the utmost importance that the Clerk of Works see that it is run at least six weeks before it is required for use, to avoid free lime in the finished work, with resulting cracks and blow-offs. In no case should the putty be allowed to be run anywhere else than on the site, where it can be immediately under the Clerk of Works' eye. It is as well to give the builder the information early that no putty can be used that has not been run for the above-mentioned period, and having expressed such a decision, it must be observed. The Clerk of Works must also see that sufficient is run for the job. Also, that the proper proportion of sand is used in the coarse stuff, etc., and the mixing is as perfect as possible.

For cornice work the finest of the putty must be used, and that end furthest away from the pouring end of the pan will generally yield this.

First coat work.

Coming to actual work, the first coat does not call for many observations. It is first necessary to see that all work that it will cover up is quite satisfactory, and that the mixing and proportioning of the coarse stuff is as it should be. The fixing of the grounds for the joinery must have been previously completed. In no case should any joinery have been fixed, as the plasterers are bound to splash it, and the wet plaster is sure to damp it, causing it to swell, leaving cracks or gaps between the plastering and joinery when both are dry again. Unless the grounds have been truly fixed, true plane surfaces on the walls cannot be obtained. The Clerk of Works should see to this personally, and not rely on anybody's word for it.

The walls should first be dusted and slightly wetted before any coarse stuff is applied, and it must not be overlooked that this first coat need not be a thick one; the chief objects of it have been previously given. On lathwork it must be so pressed on as to curl round the laths and form a strong key to hang up itself, and so form one for the subsequent coatings.

The method followed by the plasterers on lath-work must be watched, to make sure that the best key procurable is being obtained, which will be by pushing the trowel across the laths diagonally, *i.e.* at about an angle of 45 deg. To push the trowel at right-angles to the laths will cause it to strike the edge of each lath and considerably jar any key that might have been formed. To push the trowel the same way as the laths is equally as futile.

The scratching of the first coat must be sufficiently good to ensure a key for the second, straightening or floating coat. It must be done while the under one is moist, *i.e.* not fully set. This scratching is effected several ways by plasterers; some prefer three or four pointed ends of laths nailed to one lath, forming a rough comb, others a piece of board about 5 inches to 6 inches wide toothed on one edge, but as long as a sufficiency of key is obtained, avoiding the scratching going sufficiently deep to remove or weaken the key of the first coating, the method followed is immaterial.

The first coat should be allowed to dry before the second one is put on.

Second coat work.

On the second coat depends the trueness of the finished surface, be it on walls or ceilings. If the surface is to be finished trowelled stucco, it is quite possible that the object is to paint them at some subsequent time, and where a glossy finish is desired, every wave on the surface, particularly on the ceiling, can be seen; thus here the Clerk of Works ought to watch this second coating of plastering very keenly, much more so than when the walls are set with fine stuff for a wallpaper finish. Where grounds have been fixed for skirtings, these give the guide for plaster finish, and the Clerk of Works will see that all screeds and dots are in plane with them. On timber partitions this should result in an uniform thickness, but on brick, and particularly so on rubble walls, levelling out in places is necessary.

The Clerk of Works should have floated surfaces tested for trueness of surface from time to time; there is not the least excuse for any part of it being not all in one true plane, and consequently no excuse tendered by the foreman should be accepted.

Cornices.

The running of cornices calls for some few minutes of the time of the Clerk of Works. He must, before the plasterers arrive on the job, have obtained particulars of where cornices are to be put, and have been furnished with the details of same. If for any reason he has to furnish drawings himself he must remember that no dust-catching ledges, sinkings or hollows should be formed in a cornice.

Where cornices or mouldings run up rakes, a different mould section will be required, and it is the Clerk of

Works' duty to inspect the accuracy of this second section with the straight or first detail. This similarly applies to mouldings which, from some causes, have to be diminished or enlarged.

Straightness of lines and trueness of mitres are two points upon which too much strictness to truth cannot be insisted on, and the Clerk of Works is advised to inspect the position of the running rule, and that it is truly and well fixed. He will also look to the material used in running cornices and to the use of plaster for gauging purposes.

The setting coat does not call for any remarks, except to see that the finish is as perfect as possible, well trowelled, and, if of trowelled stucco, well polished.

Cracks, causes and remedies.

If for any reasons cracks appear soon after the work is finished, it is as well to leave them as long as the condition of the job will allow, and, finally, to have them cut out, and the places made good. The cracks may have been caused by the lime not having had sufficient sand mixed with it, or it may be by settlement ; the last is a builder's risk, and until his maintenance period is expired the cracks must be made good by his workmen ; unless, of course, the foundations were at the time of putting in not considered by him sufficiently good and he called attention to this.

Another reason of cracks is by the work drying too fast. This is not a common cause, but it is sometimes noticed in additions or alterations to buildings, where the heat, particularly if during the winter months and fires are going, dries up the work too speedily. On one building known to the writer, additional rooms built on to a wall having a heating chamber flue in it, caused the plaster work and Portland cement dado to crack from top to bottom of each room, and it was necessary to leave the cutting out and remedying until the month of May, when the hot water apparatus, and consequently the flue, was put out of use for the summer months.

The angles of projections need to be looked to. These may be arrised, rounded or moulded, and may be finished in the fine stuff or Keene's cement. The Clerk of Works will have determined beforehand the finish to each angle. Where Keene's angles are described to be on Portland cement backing, he will see that the backing is put in, and that the "returns" are of the width specified.

Works in Keene's.

Other points he will watch are the flush Portland cement skirtings, that they are as truly perpendicular as the walls above, and the bead or mould is of correct section and clean; that stops to moulded angles are neatly formed; that circular moulded or plain work is to a true radius for the whole of its length; that junctions of circular with straight work are properly made without crook; that flutes in columns and pilasters are correctly set out and worked to; and that where quirks are required they are put; that modillions and other ornaments are neatly *and firmly* fixed, and are correctly spaced.

The architect will provide detail drawings of caps to columns, etc., and models may have to be submitted. The Clerk of Works will see that the finished work agrees with the approved models or the details furnished.

In the case of old buildings being restored, all plaster work must be carefully inspected, as under its coating of colouring matter ancient decoration may be revealed. In all cases of doubt, the work on the portion in question must be stopped until the architect or other competent authority has personally inspected the work. If the walls are of soft stone, and they probably are if the building is rendered externally, the repairs should be made with lias lime.

Restoration work.

The portion to be repaired or renewed must be well brushed down, and the joints raked out sufficiently to give a key, and the old stone wetted before the rendering is put on, and for external work this rendering should be kept damp by wetted cloths, or it can be syringed night and morning, and in all cases it should be protected from the wind and sun by tarpaulins. It is necessary to see that all moss and vegetable matter is removed before any new rendering is applied.

CHAPTER XVI

SUPERVISION OF GLASS AND GLAZING

The shortest bill in the quantities isthat of the glazier ; it is also the trade that there is least for the Clerk of Works to watch.

The specification will give the kind of glass to be used in the various parts of the buildings, and also the weights per square foot.

Before the foreman sends on to his firm the sizes of the sashes and frames, the Clerk of Works must have ascertained the actual glass for each sash, as variations on those specified may have to be made, for being on the job he is best able to see whether it is not necessary to substitute an obscured glass in some positions for clear sheet specified. It may be that a window overlooks the lavatory apartments of another building, or in the case of a school it may be deemed advisable to obscure the lower panes of a sash in order to prevent the attractions of the street diverting the attention of the scholars from their lessons.

Any variations suggested should be submitted to the architect for his approval, in time for the foreman to place his order soon enough to prevent delay.

Defects in glass.

The most common defects in glass are air-bubbles, scratches, and waviness. The weight must also be checked. When sashes come already glazed on to the job, it is as well to sample one or two by cutting back the putty and measuring the difference between depth of rebate and depth from edge of sash to face of glass.

The quality of sheet glass must be looked to; for decent work "seconds" will be used. The quality can be told by the freedom of the surface from waves, which can be seen by looking along the surface of the glass, and the better qualities are more free from air bubbles than the lower ones. The lower qualities also distort the appearance of objects.

British polished plate can be distinguished from patent plate by the air bubbles in the latter being elongated in contrast to the circular ones of the former.

As plate-glass is usually employed on account of size and strength, damage done in glazing is an expensive item to replace. The Clerk of Works should see that it is not scratched in this operation, and if there is the least likelihood of a girder, say, over a shop front settling, a groove about ½ inch deeper and ⅛ inch wider than the thickness of the glass should be put in the sash or shop front head below the level of the rebate, so that the glass may slide into same if for any reason the head comes under pressure. In some cases with putty glazing it may be advisable to use a putty or cement that is not too rigid when set, when plasticine or marine glue would probably answer.

Glazing notes.

In all cases of putty glazing the Clerk of Works will see that the rebate is primed before the putty is put in, that the glass is sprigged to prevent the glass moving forward, and that the finished putty is neatly bevelled, and does not stand up above the sight line of the sash rail or style; where it does so, the rebate must be made deeper, unless the slope of the putty can be flattened.

When glazing is specified to be with glazing beads, the Clerk of Works will see that they are of the correct detail, that the brass cups are neatly let in, and that the screws to same are of sufficient length and of correct size. When glazing has to be with blacked edges, as to plate-glass, it must be so executed, and the bedding of glass in washleather or black ribbon velvet must not be omitted where such means are directed. The trimming of the edges of the washleather must be neatly done.

Pavement lights

The pavement lights will require looking to, to see that the prisms are put in the correct way, and that the frames are properly fixed. The Clerk of Works should see that rain-water does not penetrate through the joints, and should test each light by having two or three buckets of water thrown down over them, or by postponing his inspection until a rainy week or season. In any case, he will see that the joists (if any) supporting them are sufficiently strong for their purpose, and do not give under traffic over them, as if they do the joints will always be a source of trouble.

Leaded lights.

The lead lights will probably have to be to approved design or of a stated prime cost per foot superficial. Where the architect provides the design, it should be received in time to prevent delay. Where the builder has to submit manufacturers' designs for approval, these should be obtained as early as possible. The designs will show the number of saddle bars required. The Clerk of Works will see that these are put in and that the glass is securely fixed to them.

As regards the leaded lights themselves, he must see that the lips of the cames are at all places neatly and well-dressed down on to the glass, and that the cementing material has not run out on to the glass, and that the lights are watertight.

Some of the points the Clerk of Works should pay particular attention to are that the back putty of the glazing is not cut off too soon—that between the glass and the rebate should be set before any attempt is made to cut off the squeezed-out portion ; that in long skylights where the glass has to be in two or more lengths the specified tingles of copper are put in, and that the lap of the lengths is uniform in between the several bars ; that, if patent glazings are specified to be executed by the patentee's own workmen, these are actually employed; that at least ten days elapse between the glazing of sashes and the fixing of them; that on the completion of the job the glass is left clean, and freed from all paint stains or splashes, and that in the removing of these the glass is not scratched. Obstinate paint stains can generally be removed by brushing over them with a paste of freshly slaked lime and potash, allowing the paste to remain for three or four hours, and then working same up with clean water, and finally sponging off—often a small piece of felt dipped into a knife powder and used with a circular motion will answer; that in embossed glass no splashes of the acid used appear on portion outside the embossing area, and that the embossing is evenly and neatly executed; and finally that there are no cracked or defective panes of glass anywhere throughout the building at completion.

CHAPTER XVII

THE SUPERVISION OF PAINTING

Preliminaries.

When the time comes for the painting to be commenced, the Clerk of Works will see that all other trades are completed with the exception of a few items of ironmongery. On his rounds of inspection he will note the joinery is satisfactorily fixed, that the plasterers have properly completed their work, and that when once a room has been handed over to the painters it is not, at any time afterwards, used either as a messroom, workshop, or as a means of entrance or exit from or to any other room or parts of a building.

It is the Clerk of Works' place to settle the order in which the painting is to proceed, and the order of sequence he directs must avoid the passing to and from mentioned above.

The exact tints to be used will be notified to the builders early, and if a special make of paint is specified the Clerk of Works will inspect each consignment before any of the cans or drums are opened. On no account should he allow cans, etc., brought from another job to be used until he has satisfied himself that they contain the actual paint specified, and not merely a substituted one put up into the kegs of the specified firm.

Paints are very much alike, both to the eye and the nose, and if there is any doubt, and the specification permits of an analytical test, the Clerk of Works should send a sample to the chemist approved, giving the full particulars of what it is supposed to be.

The supervision of painting from the point of view of the quality of the paint is a difficult matter. When ready-made paints of particular firms are specified, if the Clerk of Works sees the cans delivered unopened, he can be practically sure that he is getting what the specification demands.

With paints made up on the job, he can only check the quality by inspecting the materials from which they are made up and by watching them in the mixing. After they are made up he has very little to guide him beyond his experience, his eyes, and his sense of smell.

Very few Clerks of Works can be chemists; they have neither the time nor the opportunities to qualify as experts in testing paints, and as ready-made paints are coming more generally into use (and if respectable firms are specified), there is less need now than formerly for them to have a chemical knowledge of paints, etc. Yet at the same time the properties of oils, etc., must be known, *e.g.* when boiled oil is preferable to raw oil, and *vice versâ*.

On a job of fair size, using paint mixed upon the works, it is as well for the Clerk of Works to set aside one particular room for a painter's store, and for mixing the paint up in, and to insist that only one or two men do the actual making up. These can be told the requirements, and the likelihood of incorrect mixing thus reduced.

Inspection of materials, etc.

Inspection should be made of the materials and plant immediately it is sent to the job. The pots and cans must be clean, and sufficient must have been sent for the number of men employed; this also applies to brushes. To do best work, good brushes are essential, and the Clerk of Works will object to any that are beyond fitness for work. He will also see that the step-ladders are sound, with the cords in good condition.

The white lead, zinc white, oils, driers, and varnishes must all be looked at as they are brought into use. If all paints are to have a zinc base, white lead should be prohibited in the painters' shop. If the builders are dealing with reputable firms, and the kegs, cans, etc., are labelled, or the delivery notes seen, it is as near as the average Clerk of Works can get to ascertaining that the materials supplied are up to the standard required.

The best test is the resultant work. As regards turpentine, the best will leave no oily mark on a piece of paper if held in front of a fire so that it evaporates; it will also remain clear for a month if exposed to the air in a jar, being covered by a fine muslin cloth to keep out dust, etc. As regards smell, the best is refreshing rather than unpleasant.

With linseed oil, the smell, colour, and weight can be used to form an opinion as to its quality. Boiled oil spread upon a piece of glass should form a skin in twenty-four hours. It should be clear, but darker in colour than raw oil. A dark and cloudy oil should be refused.

With ready-made paints specified, without doubt the architect knows the quality and covering powers, and the Clerk of Works can, if necessary, get any information required from him. If these are enamel paints, they should dry hard, and require a sharp blow to chip the surface. The time taken to dry and the freedom from tackiness, and the separation of the vehicle from the pigment during the drying should be noted.

A rough test for colour of a varnish is to spread some on a piece of white flatted paintwork. This will also show the body and flow of the varnish. By spreading some on a piece of plate glass, a test of drying is obtained, and also of hardness. The thumbnail pressed on at intervals will show the speed of drying, and eventually the quality of hardness. The varnish should dry throughout, and not merely a hard skin form on the surface.

Coming to actual work, each coat should be of a distinct colour or tint, and each one must be inspected by the Clerk of Works before the next coat is put on. On this point the Clerk of Works must insist. In deciding the tints for the several coats the finishing colour must be borne in mind with each.

Dusting, glass-papering, etc.

In inspecting work to see if it is fit for painting upon, it must be seen that the surfaces are dry and free from grease, grit, etc. If walls are to be painted all sweating or signs of moisture must completely have passed off (new walls should not be painted if anyhow avoidable until they have been out of the plasterer's hands six months; if less time has to suffice, artificial means of drying should be resorted to). Assuming they are fit for painting on, all dust and grit, ribs, etc., must be removed, and they must be well rubbed down with a fairly coarse glass-paper.

The lack of and the imperfect use of glass-paper is often a predominating error in the preliminary work of painting. Every painter should carry and use the paper, and yet on many jobs it is often found that only one in every three or four have it in their apron pocket or overalls, and that those who do possess it do not make the best use of it. For plain surfaces it should be wrapped round a piece of cork. To use it in front of the four fingers will not ensure a well-rubbed surface; the fingers allow it to glide over ridges or grit. So that the Clerk of Works should see that pieces of cork are provided and used, and also that the cork is shifted from time to time, so that new surfaces of the glass-paper are used. After glass-papering the surfaces must be dusted. It is these small items that go to make good work.

Matching colours.

If the works are additions or alterations, and existing colours have to be matched, the foreman painter should submit sample tints on glass or thin boards to the Clerk of Works for approval. The samples should be the result of the same number of coats as have to be put on in the new work. In comparing the proposed tint with the existing, it is essential to do so on a bright day in a good light, but not in direct sunlight, and as surroundings, furniture, draperies, etc., affect the appearance of the colour of the paint requiring matching it must be seen that these are eliminated at this inspection, which is best done by placing a fair-sized piece of white paper, taking care that it is really white, over the colour to be matched, and viewing the proposed match and the existing colour through a hole in the white covering.

If the Clerk of Works has a knowledge of colours he may be able to suggest what toning or lowing colours to add to make the match as near perfect as one can be, but this last is really a matter for the painter rather than the Clerk of Works, and is best left to the former.

Preparatory work.

The Clerk of Works will particularly watch the painters at the various operations, as dusting, knotting, stopping, priming, rubbing down and coating. Loose knots should be removed, when so directed by the Clerk of Works, and be replaced by sound wood, carefully let in, and before the priming is put on the knots and resinous parts must be covered with knotting, which should not be put on too thick, nor yet so as to leave a raised edge; all glue tears must be removed, and nails punched well below the surface, and the whole surface be gone over with glass-paper.

It must be seen that the mouldings are smooth with good arrises and quirks; any that glass-papering will not bring to a good finish must be taken out and better surfaced material put in.

If for any reason plastering has been done adjacent to woodwork after the latter has been fixed, the splashes must be carefully removed, but as mentioned in the notes on the supervision of plastering, there should be no reason for this to occur, except for framed grounds.

Priming, stopping, etc.

Before the actual priming coat is commenced the whole surface must be well dusted down, as dust remaining will cause the surface to be rough. The priming coat must not be too thin, nor yet should it be too thick. If too thin it will in all probability all sink into the wood, not leaving sufficient covering to act as a key for the second coat, and if there is not a complete contact between the priming and the second colouring blistering may result.

The priming should go well into nail-holes and other sinkings, as otherwise the stopping will not adhere properly, and the heads of nails should be well covered to avoid rusting through. Any large holes for hand-rail screws or sunk nuts for bolts should be sufficiently below the surface to allow of the holes being filled up by carefully letting in pieces of wood.

The Clerk of Works must see that the stopping is pressed in solidly and that the work round the hole or sinking is kept free from the stopping material, which, for best work, should be of white lead, whiting, and raw oil, so as to form a hard putty.

In the rubbing down which follows the stopping it is important to see that the arrises and true shape of mouldings are kept, which can only be done by folding and bending the glass-paper to the section of the moulding.

Unless the Clerk of Works keeps a strict eye on this part of the work the arrises will be rounded, and rounded members will be flattened, and the new woodwork will have the appearance of old after painting.

Second and following coats.

In the subsequent coatings, thin coats should be aimed at, so long as a covering is obtained, and the paint put on at each brush must be well worked out before any laying off is attempted. The points the Clerk of Works will look to are: That the paint is not put on so thick or not worked out sufficiently as to leave a corded surface; that fatness of paint is avoided at edges; that tears do not form; that in woodwork the paint is laid off in the direction of the grain; that on walls it is laid off in a vertical direction; and to skirtings and other narrow borders horizontally.

It must be seen that the under coats do not grin through the finishing coat by the last being too thin, or that the under coat is too deep in tint for the final one to cover.

The weather must be suitable. If done in frosty or foggy weather, parts of the work may flash. If a flat finishing coat is specified, the Clerk of Works will see that the under coat is glossy; similarly a high gloss cannot be obtained upon a glossy surface. When this finish is demanded, the under coat must be fairly flat.

Faults in painting.

It is very disappointing to see work blistering as soon as it is finished, but if the Clerk of Works sees that pure linseed and boiled oils are used, that the work is fit for painting upon, that knots are properly covered with a pure shellac knotting, and the resinous places similarly protected, that no moisture is either imprisoned in the wood or between the several coats of paint, he will be reducing the likelihood to a minimum.

The risk is the builder's so long as his men are on the job, and his maintenance period has not expired, and any work not satisfactory from this cause must be removed by burning off and be replaced. In some instances it may be worth while to go over all resinous places or knots with a lamp in order to bring the resin to the surface, so that it can be scraped away. If pitch pine has to be painted, it is often quite necessary to go over it with the lamp, as owing to its resinous character it is much more apt to blister than ordinary deal. If this is not considered necessary or advantageous, a coat of good knotting to the more resinous parts should be applied. Another way in which water gets into the work is by the painter covering up white lead, dryers, etc., in the castes with water.

Where this is done, the Clerk of Works should see that it is well beaten out before mixed up into colour. Similarly, brushes stood in water must be well worked out before being put into the paint. The better plan is to insist on the lead, driers, etc., being covered with raw oil, and the brushes to be kept in turps. Where "best" work is specified this is not a too stringent demand.

If by accident work gets damaged, it is generally unsatisfactory to touch it up, but the Clerk of Works should wait until it is quite dry, and then, if necessary, direct the rubbing down and repainting of the whole of the damaged surface.

It is best to leave the sequence of the painting in a room to the painters, but the principal items are generally the doors or cupboards, or other fittings having large surfaces. These should be painted when the brushes are in their best condition.

The Clerk of Works should, however, see that each portion of the work is in a fit condition to receive its next coat, before it is actually commenced upon.

When best results are required, and the time can be spared, two or three days should elapse between each coating, particularly between the earlier coats, which should be harder than those above them, and this hardness is obtained by allowing them sufficient time in which to pick up the necessary amount of oxygen they require to do so.

When the subsequent coats are put over coats that have not had sufficient time for this purpose, there is the likelihood of the last coats cracking in order that by a natural endeavour the under coats may get the amount of oxygen they require.

Varnished work.

With varnished work it is of the utmost importance to see that the work is entirely free from dust, grit, grease, etc., and, if necessary, the Clerk of Works should insist on the floors being sprinkled to lay the dust, and it is well to choose a day when the wind is practically still, and the temperature not too low or yet too heavy.

The Clerk of Works will inspect the varnish cans and make sure the specified firms are supplying it. He will see that the kettles and tins are clean, and also the brushes, also that in putting on the varnish that an even thickness of flow is obtained, free from tears or runs, and with the corners and quirks free from wrinkles. The woodwork to be varnished must be sized as directed by the specification, but it is very necessary to see that the whole of the surface is gone over, as otherwise portions of the subsequent varnishing will sink in where the size has not covered, and will yield a sleepy patch. Where three or four coats of varnish are specified, the sizing will be probably omitted from the specification. The Clerk of Works will inspect the varnishing as it is completed; any that is blooming must be re-varnished unless it is possible to restore it by rubbing the surfaces with warm water, which may answer when the cause is from frost or moisture condensing upon it before it is hardened; but the writer has never found this rubbing restore it satisfactorily, and looks upon it as so much waste of time in attempting it, but there is no harm in allowing the painter to make the attempt, always understanding that, if it is not satisfactory, revarnishing will be insisted upon. Assuming the weather conditions are entirely favourable and the cause mentioned above cannot be the reason of the blooming, it may be that there is water contained in the varnish, when the can from which it was obtained should be removed from the job, or its contents noted, and the can marked or sealed to prevent its use on other parts of the building.

If any surfaces become pitted, they must be revarnished. The weather not being suitable, or by using brushes not thoroughly freed of turpentine, may cause these marks.

Any work that cracks must be removed and redone, as it is most commonly caused by using two varnishes of different elastic properties, though varnishing on paint-work which is not thoroughly dry will cause it also.

The Clerk of Works will be on the outlook for the scamping practice of adding oil or turpentine to varnish so as to make it work more easily and smoothly. He will also see that the varnishes of different makers are not mixed together by the painters.

It would be possible to enlarge upon the items or points that Clerks of Works should note or be on the watch for, but experience is the best teacher, although the notes given above may assist that official upon his first job; but he can never be wrong in seeing that dust, grease, draughts, etc., are never present at the time of painting and varnishing.

Notes on the cleaning and painting of ironwork appeared in the notes on supervision of the smith and founder.

Although all the faults mentioned above are risks of the builders', yet it is up to the Clerk of Works to do all in his power to avoid them happening, as they mean delay, and time is generally the essence of the contract, and certainly delay is one of the questions upon which he will be called upon for an explanation, if the contract time is exceeded.

Distempered work.

It would be as well, perhaps, in these notes to give a few hints on stopping cracks, holes, etc., distempering, staining, etc. When old walls have to be distempered or painted, the cracks must always be carefully seen to. Cracks should be cut out at least half an inch wide, and should be undercut at the edges, in order that the stopping may be dovetail in section. To merely stop from one side of the crack to the other usually leaves a bevelled surface, as the two sides of the opening are most frequently not in one plane, so that by widening the width of the crack the stopping is spread over an increased area, and the bevelling, if any, is less noticeable. After cutting out, all dust and loose plaster must be removed from the cracks, which must then be painted or well wetted, when the stopping can be put in. When this is dry, the surface must be glass-papered down. If the Clerk of Works will personally see to these small items, the cutting out of the cracks and the proper stopping of them, there should be little possibility of their presence being known when the wall is finally painted or distempered.

In redistempering, the Clerk of Works will see that all old distemper is washed off, which is not always readily done, especially if the old distemper had something, *e.g.* oil, put in it to bind or fix it. In such cases clairecolle is necessary to ensure an even surface of distemper. which cannot result unless the whole surface of the wall or ceiling is equally absorbent. If clairecolle is not specified, permission from the architect should be obtained to have it put on.

The cause of any old stains in ceilings and wall surfaces must be ascertained and the cause removed before any new work is executed. The stains are best covered with a coat of knotting or of flat paint.

The points the Clerk of Works has to look to in supervising distempering are that the surfaces are fit for covering, that a good round coat is put on, that the tint is kept uniform by the stirring of the distemper, that the cornice mouldings, quirks and enrichment are not filled in with distemper so as to hide their lines, that if patent washable distempers, as Duresco, Hall's, are used, the directions issued with them are followed. As with paint and varnish work, the presence of grease is one of the greatest of all drawbacks; on new work it should not be present, but on old work one is sure to meet with it, when it is as well to have the patches coated with a solution of lime and soda, which can, after a space of a few hours, be washed off and the spots then be gone over with a size in which alum has been dissolved.

Stencil work.

If the builders have to submit designs of stencils they should send in their patterns to the Clerk of Works as soon as the painters arrive on the job. The Clerk of Works will submit same to the architect. The design at the corners will need watching at the time of stencilling. Where the architect furnishes the designs, the Clerk of Works will inspect the stencil plates.

Where surfaces are not cut in, a dividing line is run. The Clerk of Works should see that this is lined in and not stencilled, unless the specification distinctly permits stencilling. In the run line, it must be seen that both edges are parallel and that the line is of uniform width.

Staining.

If any work has to be stained, the Clerk of Works will direct that it is left clean from the plane, and that it is not to be glass papered. The finished tint will be submitted for the architect's approval on pieces of similar wood to that upon which the work has to be executed. It should be seen that the first coat of stain put on is not too dark, as it can always be darkened by a second application. The finish must present an evenness of stain and of surface, some woods roughing up under water stains. The Clerk of Works will see that the specified number of coats of sizing and varnishing are put on.

CHAPTER XVIII

HIS OFFICE AND OFFICE WORK

THE office work must of necessity be looked upon as a secondary part of the duty of a Clerk of Works, as his first and main duty is that of supervision, and under no circumstances must he allow any writing, either letter writing or diary keeping, to interfere with the more important work of supervising the labour and materials on the job. If the work calls at times for the whole of time to be spent on the scaffolds, then the office work must be done after the working-hours of the men are over, either doing it at home or staying behind in his office. The conscientious Clerk of Works will not jib at unpaid overtime, but at the same time the salary should be such as to make his working hours be reasonably recompensed; but something will be said on this subject later.

Although not so important as the work of supervision, yet the office work is nevertheless important, and must not be neglected on the score of no time. A carefully kept note-book, a well indexed letter or manifold copying book and a properly entered dimension book of variations are of great use to the architect and the surveyor who adjusts the variations at the completion of the job.

Office described.

It would perhaps be well, first, to say a few words about the office in which the Clerk of Works is to do this part of his work. The specification and conditions of contract will show that a Clerk of Works is to be employed, and the former will most probably mention the office for him, describing its size and fittings. If by an oversight this is not given, the architect must be consulted, and when permission is received, it must be furnished by day work or by measured work on a schedule.

The size will vary with the largeness of the works to be erected, as the larger ones will in all probability necessitate the Clerk of Works having assistants, when the office must be of an area to accommodate all of them.

The shape may have to depend on the space available on the site for the office to be placed, and in some cases it may be necessary to forego some of the area specified, but in no case should a larger size be asked for than that given in the specification.

On a large site, the whole of which is not going to be covered with buildings, the office can probably be put up in one position and remain there for the length of the job, whilst on crowded sites it may be necessary to move its position from time to time.

In the former case, if the job is likely to last two years and upwards, the builders may, even if not specified, desire to build a brick office. The Clerk of Works can form his own opinion as to whether he prefers brick to a wooden one; in any case, if of the latter material it is always preferable to have the side containing the fireplace built of brick or partly of brick.

The fittings to be provided by the builders usually allow of sufficient drawers to hold the contract and full-size detail drawings, and smaller ones to take the specification, blank bills of quantities, stationery, etc. The larger drawers should certainly be large enough to take drawing paper of "double elephant" size. Some of the drawers should be under lock and key. The drawers for plans, etc., can be conveniently placed under the bench (which can run the whole length of one of the longer sides), which will be sloped, but it is as well to have a dust-board or false top between the top of the drawers and the boarding forming the slope of the drawing bench, as the joints of these boards are almost sure to open; when in dusting each morning, the dust will be swept through these apertures into the drawers, which is objectionable.

Furthermore, an accident may occur, such as the upsetting of ink or water on the drawing bench, when, running through the joints of the boards of the latter, the drawings in the drawers will become marked. Failing the supply of the false top, tongues should be put to all the cross joints of the bench boards. This is perhaps the most reasonable request to make to the builders, and as the specification is sure to ask for all cross joints to be so tongued it will therefore clearly come within the specification.

As the drawing bench will be high enough to work at standing, or will at least require a high stool, it is as well to have a table of ordinary height for doing writing on, one at which an ordinary chair can be used. If this is supplied, it does away with the risk of ink being upset on the drawing bench, to the possible spoiling of the drawings, either on it or in the drawers beneath. The fault of most specifications is that they are not full enough, and though the architect may mean or desire a writing-table to be provided, yet if it is not specified it cannot be asked for, but most builders will recognize that it is desirable, both for writing and for use as a meal-table, and it is frequently provided unasked for.

The windows need a little thought. It is, of course, essential to have some in front of the drawing bench, and one in front of the writing-table is desirable. The position of the others (if any) depends upon the view they give of the works.

It may be necessary to stipple the windows, or parts of them, to prevent undue inconvenience from inquisitive persons. It may also be advisable to have shutters to them at night.

Some of the windows must open for ventilation; whether this is effected by sliding or casement sashes must usually be left to the builders, who will no doubt consult the Clerk of Works; unless, of course, they are making use of a hut brought from a previous job. Personally, I prefer sashes hinged at the bottom, with hopper sides. They are practically draughtless.

Washing accommodation must be provided. Generally a portable lavatory basin, or a stand with a pail below, will answer the purpose, but often a builder, when the contract is a lengthy one, will offer to put in a properly trapped glazed ware basin, when the waste can be allowed to discharge into a sump hole or old drain gulley if conveniently placed.

The other items which the specifications will ask the builders to provide will be lighting, heating, and attendance. Taking these in order, the lighting may have to be by means of oil lamps, which, if properly attended to, should not become a nuisance; but on larger works, particularly if the heating is to be by gas, then the lighting can be by this means also. On some jobs known to the writer, gas has been put on to both the Clerk of Works' and builder's foreman's offices, both for lighting and heating, with a small grilling stove for cooking purposes; and it is almost certain that the saving on the attendance and the additional comfort obtained, more than compensated for the extra cost of outlay and consumption, as nothing is more annoying to either of these two officials than to find their offices full of smoke from a badly drawing fire, or to find on their return to the office after a long stay outside on the works that the fire is out and the office too cold to sit and work in.

If the heating is not by gas, coal fuel fires must be used; without doubt these are more cheerful to look at, but there is little time as a rule to enjoy this advantage, except at meal-times, and often a Clerk of Works (who perforce, owing to the distance of the works from a town, is bound to have his mid-day meal in his office) has little time to spare for that meal, and as soon as it is over is desirous of doing some of the clerical work that is ever necessary.

The attendance provided is generally a labourer or a boy, who will, before the arrival of the Clerk of Works in the morning, have swept and washed out the office, dusted the tables and chair, lit the fire, opened the windows, and generally got the office into a fit state for use. It is as well for the Clerk of Works from the first day of the use of the office, to insist on the standard of attention he requires, for instance, the hour at which the office is to be ready in the morning, and the particular hours afterwards at which the attendant is to do other necessary work.

The Clerk of Works should himself see that his papers are all put away at night, so that there is no possibility of their being disarranged or made dirty by the dusting or sweeping in the morning. A good attendant in a few weeks learns to anticipate the Clerk of Works' wants, and, where instructions have been given from the start of the Clerk of Works' requirements, there should never be the need of having to hunt all through the works to find the attendant who has neglected to trim or light the lamp, or leave a sufficient supply of coal in the scuttle.

The contractors should also find the drawing-board and tee-square for the Clerk of Works. These should be of reasonable quality, so that fair work as regards drawing may result.

The Clerk of Works should look upon the office as his private property so long as it remains upon the job. It should not be shifted without his consent, and the foreman has no right in it without the Clerk of Works' express permission.

Clerk of Works and Foreman.

As soon as the Clerk of Works has opened his letters in the morning, and entered a précis of them in his diary, the foreman should attend at his office for any instructions that may be necessary, and to inform the Clerk of Works of any materials that have been delivered the previous day, and this opportunity can be taken by the foreman to bring to the Clerk of Works' notice any further points upon which instructions are required.

It is not always advisable for the Clerk of Works to give a decision then and there, especially if the question is one of construction, but to note the information required, and then to go into the question as soon afterwards as he conveniently can, as often a question settled hurriedly has to be altered subsequently, owing to some information discovered later on another drawing or part of the specification that was not consulted when answering the query straight off. To most questions an answer should be able to be given direct, as the Clerk of Works should have gone carefully into the details of the construction of all parts before the work has actually been put in hand—in fact, it is advisable for him always to be a floor ahead of the foreman in the construction.

Often the full-size details of stonework, terra-cotta, and joinery are only furnished to the Clerk of Works, and these the builders have to trace. They should not be removed from the Clerk of Works' office without his permission. The foreman rarely has time to copy them, and so the builders send a draughtsman out to trace them, when the Clerk of Works can lend his office for this purpose, as the foreman's is generally smaller and often has part of its space filled with goods or tools.

If the builders desire them sent to their office to trace, the Clerk of Works should, if he agrees to this being done, hand them to the foreman, and obtain a receipt from him for them. It is as well to agree to some stated number of days within which they are to be returned. In the event of this number of days being exceeded, it is open to the Clerk of Works to refuse to send them others that come in later and to insist that they send some one to his office to trace them.

Records to be kept.

The Clerk of Works should keep a record of all drawings received. If any of the details have to be traced by the Clerk of Works and returned to the architect, the traced copy should be sent back to the latter, and the original kept for the builders to work from. But the tracing of details is best done by the architect's office assistants, who have more and better facilities for doing it, and also the Clerk of Works' time can be better employed with some contractors ; but there is this to be said for the Clerk of Works tracing them, that it impresses the details upon his memory. In any case he must most carefully look over them, as often there are errors in the drawing, which he, being on the job, should be the first to discover.

The record of drawings is best kept on forms of which that on page 152 is a suggestion. If the drawings are not numbered or lettered when received, the Clerk of Works will number them for himself, and should in this case notify the builder of the numbers he has given to each. The number will be useful when writing to the contractor with reference to something shown on that particular sheet. But as a rule all drawings are numbered before they leave the architect's office.

Of the office work, diary keeping is the most important, as from the diary the weekly report information can be obtained, and if properly kept is an invaluable record at the time of adjusting variations, when time and weather are in dispute. The diary should refer to one job only, *i.e.* a fresh one should be commenced on the first day of arrival to take up the post, and the book or books at completion should become the property of the architect, for often some question may arise at a later time which the diary may help to settle, and if in the possession of the Clerk of Works may be difficult to get at, so that the architect should either provide the diary or sanction its purchase.

The book itself should not be too small, and, in the writer's opinion, it is best to have a separate page for each day of the week, as on some occasions the information to be entered may be sufficient to fill a sheet of foolscap.

In making entries in the diary, the Clerk of Works cannot be too careful of accuracy of expression, of entries being made in their correct order, and lastly that nothing is omitted. An item which at the time appears as but trifling may in the light of subsequent events assume large dimensions, and in diary-keeping there is no putting in an item some time after it has occurred to a previous date in the book, as by so doing the honesty of the whole diary is brought into question; and a diary about which there is a doubt is worthless.

The time of the day at which to make the entries in the diary is a matter of opinion, as some make all their entries at the close of the day, whilst other Clerks of Works make them *as soon after as possible* as the matter to which the note is to have reference occurs, and of the two systems the latter is most probably the most accurate in fact, as it obviates the risk of forgetting any happening of the day; but at the same time a note often made in the morning is found of no value before the day closes, subsequent events having nullified it, and this system means less clerical work. The diary is entered up from notes made in a pocket-book at the time, the diary being kept under lock and key in his office.

The note-book is an important book also, and in the case of a challenged diary at the settlement of variations, the note-book will be called into evidence. A separate note-book is best kept for each job also, and the entries in it may be quite rough, often merely headings; but it is important that each entry made should bear a date, and the Clerk of Works is advised, before making an entry on any day in this book, to first of all insert the date.

In the case of any entry needing certifying, by foreman, workman or other person, the note-book entry is the one to be certified, as the diary must be kept strictly private from everyone except the architect, until the completion of the job, unless interim adjustment of variations or valuations are made, and the diary is required to confirm or refute some evidence or statement made.

List of Contract and Detail Drawings.

COBCHESTER TOWN HALL.

Number of Drawing	Description		Scale	Class of Drawing	Date Received	Traced & Returned to Architect	Traced by Builder
1	*Plan*	*Basement*	*⅛-inch*	*Contract*	*3 10 11*	——	——
2	*Plan*	*Ground Floor*	*⅛-inch*	*Contract*	*3 10 11*	——	——
...	....			...	...	...	...
17	*Sections*	*Main Floor*	*½-inch*	*Contract*	*3 10 11*	——	——
...	....		...	...	...	...	...
21	*Stairs*	*Main*	*½-inch*	*Contract*	*3 10 11*	——	——
...	....		...	...	...	...	...
25	*Ground Floor Windows*		*Full size*	*Detail Stonework*	*7 4 12*	*10 4 12*	*17 4 12*
26	*String Courses*	*1st Floor Level*	*Full size*	*Detail Stonework*	*7 4 12*	*10 4 12*	*17 4 12*
...	....		...	...	...	...	...
48	*Pediment*	*Main Front*	*Full size*	*Detail Stonework*	*20 5 12*	*25 5 12*	*30 5 12*

As regards size, shape and description of the note-book, I prefer one that opens end on, and is closed by a metal catch or an elastic band, and it certainly must be of a size that will go conveniently into the handiest pocket of the suit being worn, and preferably should be of plain, *i.e.* unruled, paper, this being best for making sketches on, the ruled lines, when present, often becoming confusing. Failing a perfectly plain paper note-book, one with small squares can be made to answer. but in this case the squares should be $\frac{1}{8}$ in. or $\frac{1}{4}$ in., or some other proportionate part to an inch to permit of being used as a guide for a scale in drawing. The fainter the squares the better. White paper may give better results than coloured if any sketches require colouring, but this is rarely needed in a note-book sketch.

Returning to the diary, the items to enter may require some consideration by the Clerk of Works on his first appointment. He must not forget that his work is supervision, and that he is not to spend much of his time in the office doing clerical work. So that he cannot attempt to record everything that occurs, but he must see that he records *everything about which a question may be asked at a later date*, so that he will find it wise to always note the state of the weather and the state of the works first thing each morning, and anything causing or likely to cause delay, such as lack of plant material or workmen.

The Contractor will most probably by the conditions of contract, be allowed additional time to that fixed by contract, for bad building weather, and the Clerk of Works will have to show on his weekly report the time lost from this cause, and he will find it next to impossible to remember the weather of each day at the end of the week, when required for his report to the architect, so that he is strongly advised to make a point of recording the time lost for inclement weather daily, with the cause, as frost, rain, flood, etc.

As regards the allowances to the builder, there is no need to keep these in hours, but rather in days and halves, and sometimes, if you like, in quarters of days, but there is no need to go into other fractions.

On going round a large building work in the mornings, the advance of one day's work over the other is hardly perceptible, except when an actual floor or roof level is reached, or the one or the other covered in, that it may puzzle the Clerk of Works on his first appointment how to record progress or delay in his note-book.

The system I generally followed was, after the first week or two, *i.e.* until I had got a firm hold of the job and knew the style of contractors I had to deal with, I sized up the job and roughly worked out at what date the various floors and roofs should be reached in the erection, the dates that plastering, painting, etc., should begin, in order to allow the contractor ample time to complete within that specified in the conditions, allowing for the strictness of the specification and the likelihood of delay from attempts to avoid it, this depending upon the class of builders and the foreman engaged on the work.

Then when in my morning walks I found evident signs of these times being overrun, I looked upon it as the likelihood of there being delay in completion, and so made a note of the need of more material, plant, or workmen as the case might be, in order to arrive at the state required by the desired date. When there were no signs of the date being exceeded, there was no need to make a note.

There is no need to inform the foreman of the dates at which you expect certain parts of the work to be completed, as it lies with the Clerk of Works to hurry on the work, and where work is ready for proceeding with and the builders do not proceed with it, it is then that the Clerk of Works must write them and inform them of delay, being careful to make a note of the condition of the work at the time of writing, in case that information is required if the contract time is exceeded and explanations are asked for.

Of course, the dates originally fixed on may have to be altered from time to time, consequent upon additional works being executed, strikes interfering with progress, and other causes.

The architect may provide the Clerk of Works with a letter-copying book, or one with carbon sheets; either will suffice, but the latter dispenses with the need for a letter press, and is in most cases preferable. The letter-book or the manifold copying book must be indexed, not only for the convenience of the Clerk of Works, but afterwards for that of the architect, to whom the book will eventually pass.

The index, besides giving the page and to whom the letter was sent, should give the date and the subject of the letter also. To give the page and person is useless, as most of the letters written will be to the contractor or to the architect, and to turn to an index which merely gives a list of page numbers against a name is not of any use, as each has to be turned up to see the subject-matter, though I am afraid that this is the way an index is compiled by Clerks of Works with no office training or liking for clerical work. It is best to keep in the index a separate line for each letter written, when the index would be somewhat as on page 156, where J. Mabon, Esq., is the architect, Messrs. Mackenzie and Co. the contractors or builders, and Messrs. Sutton and Co., Ltd., the steel constructional engineers.

If the letter book does not contain sheets prepared for indexing, some must be ruled, allowing a sufficient number of pages for each letter. It has been said that a subject or technical book without an index is worthless, and a letter-book without one is of as little value; an index is a certain means of saving the temper.

A copy should be kept of each letter written, no matter how little its importance may be, as it is always the letter of which no copy was kept that is asked for; furthermore, just as an entry in a diary made subsequently to the proper date throws a doubt upon the

LETTER COPYING BOOK.

Index.

Mabon, J.	3	5 10 11	Notifying private address.
Mackenzie and Co. ...	4	5 10 11	Asking to be supplied with drawing board and tee square.
Ditto	6	7 10 11	Requesting samples of glazed bricks and facings.
Mabon, J.	10	12 10 11	Submitting names of sub-contractor proposed by builders for reinforced stairs.
....	....		....
Sutton and Co., Ltd. ...	17	19 10 11	As to when it will be convenient to select pieces for testing purposes.
Ditto	23	24 10 11	Informing them that Girder 34 should be 14 in. × 6 in. × 57 lbs. instead of × 46 lbs. as shown.

honesty of the whole of its contents, so does the fact of not copying one letter, if found out later at the time of a dispute with the builders, leave a doubt as to the writing of others, copied, and said by the builder not to have been received.

Letter writing.

To some men taking up a post of Clerk of Works for the first time, and being perhaps the first occasion on which they have had to do any letter writing for business purposes, the writing of letters is a matter of some moment. As has been previously said, it is only part of the secondary duties of a Clerk of Works, yet it is, and should be, one of the qualifications demanded of the aspirant for the post, that he is able to express himself clearly in a letter.

The points to remember are that a letter should be short; yet the subject of the letter should be clear beyond misconstruction. Short sentences should be aimed at, and when the matter being written about has been explained, it should be left alone and not repeated in other words in another paragraph. Each letter should be dated, and the name and address to whom it is sent should appear on each letter. It should be written in a cool mood, *i.e.* any personal feeling should not enter into the subject, and any direction given should be clear and decisive.

In giving a decision in writing, it is as well to state the reason in the case of rejection of materials or workmanship, as by so doing you avoid the necessity of the builder writing later to know the reason why. Before writing, make sure of your facts, and weigh up all the pros and cons on the case, in order that in case of dispute you can back up what you have said.

Roughly, the requirements of a good business letter are: (1) *Simplicity of language*; it is a common failure among young writers to make use of long and high-sounding words, where short and simpler ones would express the same meaning. (2) *Conciseness*: that is using the fewest words necessary to convey the information or express the idea ; and under this heading the use of redundant words or phrases must be omitted. (3) *Clearness of expression ;* this is an indispensable requirement of a good letter—whatever is written must be such that the receiver cannot fail to understand it. In order to express oneself clearly, the writer must first of all be quite clear himself as to what he really requires or desires to state, and when this is achieved careful selection of words must be made in order to ensure the use of the proper one, and then the words and phrases chosen must be arranged in short sentences.

Lastly, the proper use of *punctuation* adds very much to the clearness of expression, but after all the quality of a letter written is by no means an important point so long as the Clerk of Works expresses clearly what he has to say, at the correct time, in a respectful manner, and does not assume a bouncing attitude or loftiness which will cause or increase bad feeling between the receiver and himself.

Weekly reports.

Each week the Clerk of Works has to send in a report of the state of the work. This is generally entered on a specially printed form supplied by the architect. Its object is to give the latter, week by week, information as regards the progress of the work for valuation purposes, reasons of delay, and also to form a record of the actual state of the building at particular dates, so that in the event of dispute as to delay, the reports can be used as evidence as to the facts or assumptions of the builder's statement made in explanation of delay.

For this last reason the Clerk of Works should pay particular attention to the accuracy of the weekly report, and as the architect will make his valuation also from these reports, an incorrect return will either cause overpayment to be made to the builder, or the latter will be kept out of his advance for a longer time than he should be, according as the report is in excess of work done, or work executed is omitted to be included.

The report, besides giving information as to the state of the works, must give the number of men engaged on each trade, in order that the architect can see that sufficient workmen are employed, and that the progress made is satisfactory or reasonable. There is no need to put down the hours made by each trade, though some reports ask for this information, but this means obtaining a report from the foreman practically of the pay-sheet, and this the builder can reasonably refuse (unless the conditions demand it), as such information permits of the Clerk of Works or the architect deducing what is almost a prime cost of the work.

The state of the weather must be given for each day in the week, or the time that the Clerk of Works allows for inclement weather under a particular clause of the conditions of contract. The last is preferable, as being on the spot he (rather than the architect, who may be hundreds of miles away) is best judge of what time is the most reasonable to allow, the time being reckoned in days, half or quarter days, as has been previously mentioned.

These form the principal items in the Clerk of Works' weekly report, but often forms supplied ask for list of drawings received during the week, lists of materials that have been delivered, etc., but these call for no comment.

On a large job it is manifestly impossible for a Clerk of Works to know the number of men of each trade employed on the works, so that the foreman should be asked to render to the Clerk of Works each Saturday morning a return of all trades engaged and a list of all material lying on the works, or in the stores on the site, unfixed and unused. Such a list does not take long to prepare, and no foreman will refuse to hand it in; at the same time, although the foreman has signed the list, the Clerk of Works should roughly check it before inserting the particulars in his weekly report.

On some jobs, in addition to weekly reports, the progress is sometimes shown by means of sun-prints of the drawings, which as the work proceeds are coloured by the Clerk of Works and sent to the architect with the report on the Saturday. At the height shown coloured the architect inserts an arrow, and dates it, and after taking notes of the work executed from the colouring of the drawing, returns it to the Clerk of Works in time to be added to for sending with his next report. These sun-prints should include all plans, elevations and sections of the contract drawings, and according to the colouring, form a more tangible record of the progress than any written weekly report can do; but it means more office work, and less time spent on the building, and to minimize this as far as possible it would appear to be best to limit the use of the sun-prints for progress reports to those occasions when a valuation for an advance is thought due or asked for by the builders. In some cases progress is reported by means of photographs specially taken.

Some report forms have columns for the "value of the work previously executed" and "value of work since last report" to be inserted, but of course these columns are not for the Clerk of Works' use, but will be filled in in the architect's or surveyor's office. Some report forms are as shown below.

The weekly reports are numbered consecutively, and the Clerk of Works must keep a copy of each, as it may be necessary at some time to refer to a previous report, either for his own information or in reply to a query from the architect.

Daywork and Day-sheets.

The checking and keeping of the day-sheets is an important part of the Clerk of Works' duty, and here his knowledge of proportion of material to time occupied in the execution of certain work will be sometimes sorely tried. The fact that he signs the day-sheets does not make the work described an extra, for his signature merely signifies that they are a correct account of labour and material for the particular work mentioned; in fact, the Clerk of Works can, if he has any doubt on the matter, make and sign a note on the first sheet he

CLERK OF WORKS' REPORT.

No. ....

Building ....

Contractors .... Week ending ....

Trades.	Number of men employed.	Time lost, but allowed by conditions.		Clerk of Works' remarks on materials rejected, workmanship, etc.
Excavators	....	Monday ...	....	
Bricklayers	....	Tuesday ...	....	
Masons	....	Wednesday	....	
Carpenters and Joiners ...	....	Thursday	....	
Slaters or Tilers	....	Friday ...	....	
Plumbers	....	Saturday...	....	
Smiths	....		....	
Plasterers	....	Brought forward	....	
Painters and Glaziers ...	....			Drawings received (State numbers only).
Gasfitters	....	Total	....	
Labourers	....			
		Value of unused materials on site		
Total ..	....	£....................		

Present State of the Works.

(NOTE: In the real form a space of from 4″—6″ would be left.)

....

Clerk of Works.

receives to this effect. Some architects provide the forms to be used as day-sheets, and have a clause as below printed on them :—

> "This day-sheet in triplicate to be handed to the Clerk of Works not later than . . . . day in the week following that in which the described work was executed. The names of the workmen, and the hours occupied, with full description of the work, and the materials used must be entered and signed by the foreman, as representing the Builders.—Note : Such day-sheets are not necessarily vouchers for extras."

When the sheets are received by the Clerk of Works, he must carefully look into each item to see that the particular work described is not mentioned in the quantities, and if it is, there is no need for the sheet item ; but if there is the slightest doubt as to this, or the work is claimed to be carried out under different conditions to that contracted for, the sheets should be accepted, checked, and signed, thus leaving to the architect or surveyor the question of the work being extra or not.

On alteration jobs, or extensions where old work has to be broken into, the preliminary or spot item of the quantities, if not particularly clear or full in description, often lead to the need of day-sheets, and on these the Clerk of Works should, from the first, make as certain as possible of the extent of the work covered by the specification and quantities, and note quite early the existence of other work necessary but not clearly defined in the quantities, and so be prepared for the day-sheets that will inevitably be put in by a cute foreman.

If necessary, the Clerk of Works can put his query to the architect, but it must be put before the actual work is put in hand, as he cannot impede or stop the work when the builders are ready to proceed without giving them reason to complain, or causing delay, both of which he must ever guard against.

The number of day-sheets necessary on a building (other than those caused by variations) depend upon the care with which the contract drawings, specification and quantities have been prepared, but for every job a certain number are bound to be necessary. They will be given to the Clerk of Works in triplicate, all of which he will sign, one being returned to the Builders, and one sent to the architect, and the other will be retained by himself for his own information. The first received will be numbered 1, and those subsequently received will be numbered consecutively.

The points to watch before signing them besides the question of the work being day work or included in the quantities (which have already been mentioned) are, that each separate work is separately described, and that two jobs, for different purposes, and perhaps at different ends of the building, are not jumbled up together; also that the time stated is not out of all proportion to the material used. But in this question it is *always* necessary to consider at the same time the conditions under which the work was carried out, as if done from a ladder after the scaffold is struck, the time must necessarily be more in proportion to the materials used than if similar work was done at the original time of building or at a lower level.

Some foremen have been known to submit a draft day-sheet to the Clerk of Works before sending in the real sheets, but this is a sign, or is likely to be taken as an indication, of weakness or incompetency, and cannot be looked for or asked for by the Clerk of Works.

The Clerk of Works should insist on the foreman informing him when any day work or work he claims as day work will be commenced, and to refuse to recognize any work done previously to being informed, as otherwise it means having no check on the time entered on the sheets, and having to accept the foreman's return.

If a large day work portion of work is ordered, the Clerk of Works should insist on this being entered on separate sheets, and if necessary that particular men are told off for the work, and in addition to being able to request the dismissal or removal of a workman for bad workmanship, he can demand that a man who is unreasonably slow be taken off work executed by day work, for which reason the Clerk of Works should know what is a fair day's work, but again he must take into account the condition under which the work is being executed.

The Clerk of Works must see, and insist on the materials throughout all day-sheets being entered in the same denomination, *i.e.* if mortar is given in "hods" in the first sheet, let it be "hods" in each succeeding sheet, and do not allow "pails," "yards," "barrow-loads" to enter in. Of course, it is possible to reduce one to the other, but it is quite an unnecessary trouble.

Often a Clerk of Works finds that the foreman has not entered all the materials on the sheet although he knows they were used, *e.g.* if for some fire-brickwork no fireclay is entered or any other mortar; this is clearly the foreman's oversight, and will be found out later, if not by the foreman or the builders, certainly by the surveyors who adjust the variations and sheets.

So that in such cases it is as well and proper to call the foreman's attention to the omission and let him remedy it, whilst the quantity is in his and the Clerk of Works' mind, rather than to have to leave it to guesswork at the time of the settling of the sheets. Furthermore, such a course is honest, and no respectable architect would object to his Clerk of Works doing so; in fact, the latter would rather lay himself open to censure for neglecting to do so, seeing that his signature to the sheets means a certified true statement of labour and material employed in the particular work in question.

In order to be able to certify the sheets it is necessary for the Clerk of Works to take careful notes as the work goes on, entering in his note-book the time men employed on day work started on the work, its extent, and any other information that may be useful for checking the sheets when received. Some Clerks of Works obtain the information required when the foreman comes to their office first thing in the morning, and this is perhaps the best system, as if anything stated by the foreman is disputed, it can be looked into at once, instead of perhaps a week later, when the sheets are put in.

On day work the Clerk of Works can, if necessary, determine and regulate the method of execution, and often by so doing reduce the cost.

The Clerk of Works should see that the conditions decide that the contractors have to provide plant for day work, as if not he must take notes of that employed, against a claim that may be made for use or hire of same; also he cannot be too careful in taking his notes on the use and waste items, as strutting to trenches, shores, etc., in day work.

CHAPTER XIX

"GIVE AND TAKE" BETWEEN CLERK OF WORKS AND BUILDERS' FOREMEN

THAT this principle obtains on some building contracts there is no doubt. It is a dishonest one, and, with the present-day conditions of contracts, needs not exist on any.

When quantities were not provided, the question was not so acute, as the builder had to carry out the specifications, and the drawings, and the reasonable interpretations of both, and consequently the point at which "give" and "take" commenced was not clearly defined. It was not uncommon then to find that the zealous Clerk of Works traded upon this fact, and the builder's foreman consented to do work which, under the conditions of quantities forming part of the contract, would not only not have been asked for by the Clerk of Works, but was not required or expected by the architect.

At this time it is most customary for the quantities to form a definite part of the contract as representing the amount of labour and material required in the erection of the building as depicted on the contract drawings. What is not taken in the quantities, but is necessary, becomes "an extra," and, at the same time, omissions by variations and measurements in excess, can be deducted from the contract price total, at rates inserted by the builder in those quantities; the last then also form a schedule of prices for adjusting any variations that become necessary.

Under these conditions, the dividing line as to where giving and taking commences and ends is distinctly known to both the Clerk of Works and foreman, providing both have been supplied with blank, *i.e.* unpriced, copies of the bills of quantities.

These last are not always provided, but it is distinctly beneficial to both the architect and the building owner for the Clerk of Works to have a copy, and also to the builder for the foreman to be allowed one. Some builders object to their foremen having them, as they think that materials will be ordered from them, without the foreman troubling to check the amounts; but this is a fallacy and an injustice to a large body of conscientious, painstaking, and reliable men.

It is rather to the builder's interest that their representatives do have such bills, as they form a *check* upon the materials to be ordered, and the foreman is able to note excesses or omissions, and so bring these to the builder's notice, which otherwise, neither he nor his estimating clerk would probably discover, and, in some instances, have no means of discovering, except by information supplied by the foreman; particularly is this so with some of the labour only items. This is, of course, assuming the foreman has a sufficient knowledge of the rudiments of quantity surveying to know where to find the various items in the bills and also the methods of measuring the particular works and labours — which most foremen nowadays have.

Taking it, then, that both the Clerk of Works and the foreman have copies of the bills of quantities, why should there be any "give" and "take" at all? There is no reason. The builder is bound to put in all that the quantities give, and the architect is prepared to write orders for variations that become necessary—so that to act in any instance on the system of doing and let go portrays collusion between these two officials — the worst crime that either can commit.

True, both may be practical men, capable of roughly, *i.e. approximately*, determining the fair cost of a certain works which one or both desires to omit or to be executed; but they do not know the *exact* cost, as only the priced bills of quantities can give this; therefore, the foreman agreeing to do additional work to that taken and the Clerk of Works agreeing to omit or leave undone other work, one or other of them may be robbing his employer, and at the mildest opinion be working against his interests, the watching of which is one of the chief duties of both.

One reason sometimes put forward for acting on the give-and-take principle is that to ask for a variation order for each alteration found necessary, means additional work and worry for the architect, and the Clerk of Works knows that one reason, among others, for his employment is to relieve the architect of unnecessary worry.

But if the alteration, however small, is necessary, the worry must be looked upon as part of the work of the architect, and is therefore necessary worry. Furthermore, if the alteration is consequent upon inaccuracy or omissions in the drawings, it is the architect's draughtsman's worry and not the Clerk of Works; so for the latter to urge this reason for following an improper and dishonest system is not a sound one.

Another reason against this system, besides the likelihood of robbing the employer, is that it creates or inflames a spirit of trying to "do" the other—either the foreman tries to best the Clerk of Works or the Clerk of Works endeavours to get the advantage of the foreman. On a properly conducted job, where from the first the foreman has been made to understand that everything specified will be demanded and enforced, but that *all* extra works or omissions will be made the subject-matter of a written order for subsequent adjustment by qualified surveyors, there is no need for any desire to rise over the other to crop up. There is the likelihood of bad feeling being set up where the system obtains, as it is but human, for one who believes he has been bested, to endeavour to gain an increased advantage over the other, and this can only lead to unpleasantness and bitterness of feeling between two officials, upon whose good fellowship depends the progress and well-being of the works.

The question may be asked, can a contract be carried out without the system entering at all between Clerk of Works and foreman? The answer is yes—emphatically yes, providing the architect is conscientious, and the Clerk of Works and the foreman are conscientious too. If the architect is not willing to admit an error in his drawings necessitating extra work, it will be a matter of difficulty for the Clerk of Works to keep the system out, unless the foreman and the builder are particularly wide awake and keen on the conditions of the contract being rigidly adhered to, and where the granting of certificates for advances is in the hands of the architect solely, the builder is not likely to kick against the pricks when the variation involves but only a small extra.

So far as the Clerk of Works and foreman are concerned, it takes two to make a bargain, so that if the Clerk of Works has made his feeling in the matter known from the commencement of the job, the principle should not, so far as these two are concerned, get a foothold at any time, as if the Clerk of Works is not strong enough to withstand the persuasions of the foreman, and to keep his own opinion on such a matter, he is not fitted for the post he holds.

The Clerk of Works should so make his personal influence felt that the foreman can feel a sense of security that in executing any additional work he knows that a variation order is bound to follow, from the mere fact that the Clerk of Works has said it will. If this feeling of trust cannot be obtained, there is nothing else to do but to wait for the receipt of the formal order for the variation, which means delay, and it is part of the duties of both Clerk of Works and builder's foreman to press on the work to completion.

CHAPTER XX

SALARY

In the first chapter it was pointed out that the Clerk of Works is usually the servant by payment of the building owner, yet also the servant of the architect by selection and direction, and that the dual position calls for tact and diplomacy.

In interviews with the building owners, no promises of any sort should be given by the Clerk of Works, and the fewer opinions expressed the better, as what he may say may in some instances conflict with what the architect may think or hold, and so lead to argument, if not unpleasantness. If the building owner informs the Clerk of Works that he proposes to visit the works at a certain time, he should endeavour to let the architect know in time to permit of his also being on the job, if he so desires.

In the first chapter, also, when speaking of honesty as a most essential personal qualification for the applicant for the post of Clerk of Works, it was remarked that the under-paying of a Clerk of Works is a direct method of tempting him to be dishonest, the position being one in which the accepting of a bribe or gift is easily brought about, as often the distance between the architect and representative may be some few hundreds of miles, and the Clerk of Works is left for months at a time without a visit from his employer.

Now it must be seen that the qualifications demanded by the candidate for the post are many, and mean years of study in the spare hours whilst engaged practically in the day, so that in addition to the ordinary school education there is the cost of the technical training as well, so that technical posts demand a higher salary than posts of clerical duty only.

The Clerk of Works is a man of technical and practical ability, an organizer and administrator, and his salary should be consequently high. The skilled mechanic can claim his £2 7*s.* 11*d.* a week without overtime, so that the Clerk of Works, who often has to do hours of overtime without additional pay of any kind, and who has to supervise and direct the work of often hundreds of mechanics, should receive a salary much more in proportion to the wage of one of the latter, considering his training, knowledge, experience, and conditions of service, etc. ; yet it is no uncommon thing to find the services of a Clerk of Works advertised for at the ridiculously low salary of £2 2*s.*, or £2 10*s.*, or £3 per week.

To my mind, it is an insult to a body of honest, conscientious, and capable men. No respectable man of this class should be asked to receive less than £3 10*s.* per week when in charge of a job, however small. If the job cannot stand a charge of this amount, it is too small to warrant the employment of a Clerk of Works at all.

A good Clerk of Works can generally save his salary to the building owner, in many cases saving it times over by his constant and strict supervision. Of course, many Clerks of Works receive this salary, and upwards, some 5, 6, 7 or 8 guineas per week, and it is but a reasonable recompense for their ability and labours.

There is very little doubt that the reason of the smallness of some of the salaries offered to Clerks of Works in the advertisement columns of technical journals is that the body inserting the advertisement do not know sufficiently the duties of a Clerk of Works.

The body, generally the Building Committee, at the instance of the Surveyor or Engineer, give their permission or instructions for the Town Clerk or Clerk to have the advertisement made out, put in, and state the salary to be offered, often determined after discussion, and if the Surveyor is a weak man or afraid of the Committee, his suggestion for a reasonable salary is amended and cut down by that body, with the result that one which is not even equal to the foreman's, or even that of a mechanic, is inserted in the advertisement.

The Committee may not include a technical member among its number. Fancy pork butchers and dry goods men determining the salary of a technical officer. They know little of his duties beyond what the Surveyor tells them, and expect, perhaps, a good man to come forward for the salary offered.

They in all probability get a duffer, or if they do not, then they get something worse, a man who makes the proffered salary up to a living or respectable one by accepting bribes or presents.

A good, honest Clerk of Works is a boon to the architect and building owner alike. He can save the reputation of the former and the pocket of the latter. A cheap article is generally found to be dear in the end; so equally with a cheap and underpaid Clerk of Works. He is either cheap through incompetency or because he is a rogue.

Compare the work of both—the cheap *v.* the reasonably paid Clerk of Works. Take two buildings of about the same value, on one of which the £2 2*s.* a week Clerk of Works has been employed, and one on which that official has been adequately paid.

Note the finish and accuracy of each piece of work on the latter's job, note how the work is left. It is clean, and no fault is detected; it is as the architect depicted it and meant it to be. The architect is satisfied, so is the building owner, and the cost of the maintenance to the latter is saved.

The cheaper man, if he is cheap through lack of qualifications or abilities for the job, can be noticed also by the finish of his work—inaccuracies are apparent, the items of scamping are numerous—"weather" will find them out—and the architect's reputation will suffer, as also the owner's pocket, for reparation or amendments will be necessary shortly. The same results follow if the Clerk of Works is cheap, because he is dishonest, knowing he can make his salary up by selling his honour to the builders. Having thus become under their thumb, he is not able to insist on the quality of work the honest Clerk of Works can do.

The salary just given applies only to the official whose duties have been described in the preceding chapters.

Estates Clerks of Works.

There are, however, other classes of Clerks of Works —such as Estate and District Clerks of Works, whose duties are entirely different from those of the one who is engaged on the superintendence of the erection of new buildings. The former are generally in charge of large estates, or of a number of buildings in the same ownership, and their duty is the maintenance or upkeep of those properties, together with the preparation of plans and contract documents for and the carrying out of small alterations and additions. In addition to holding all the qualifications already explained, they need to be business men, as their office work will be considerably more than that described in Chapter XVIII., as they may employ workmen and buy materials direct, or give orders on local builders, so that the clerical work may be that of a small jobbing builder, with prime cost, day book and ledger accounts to keep, and also that of a practising architect.

They are also called upon at times to possess a fair knowledge of law, so far as it affects the building trade and architect's profession, *e.g* a knowledge of the laws of rights of air, light, and support, and also as regards landlord and tenant, and dilapidations.

Such additional qualifications must demand higher salaries than those given to the architect's Clerk of Works. The salary will depend upon the importance and extent of the properties or estate concerned, and generally range from £200 to £500 a year, with or without a house, and other valuable perquisites, as free water, coal, gas, garden, horse and trap, or other means of locomotion. Such positions generally carry a fair pension at the end of years of faithful service.

The Clerk of Works is a man who is the successor of many illustrious predecessors, not always spoken of by this title, but rather by the older title of "Overseer of Works." The history of Clerks of Works would form an interesting subject. Many well-known names are recorded as having acted in this capacity, but an entire history has yet to be written. Every aspirant for the post should not overlook the fact that he is doing honourable work, and should try to leave the title of Clerk of Works unsullied and respected.

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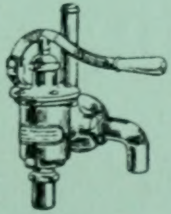

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